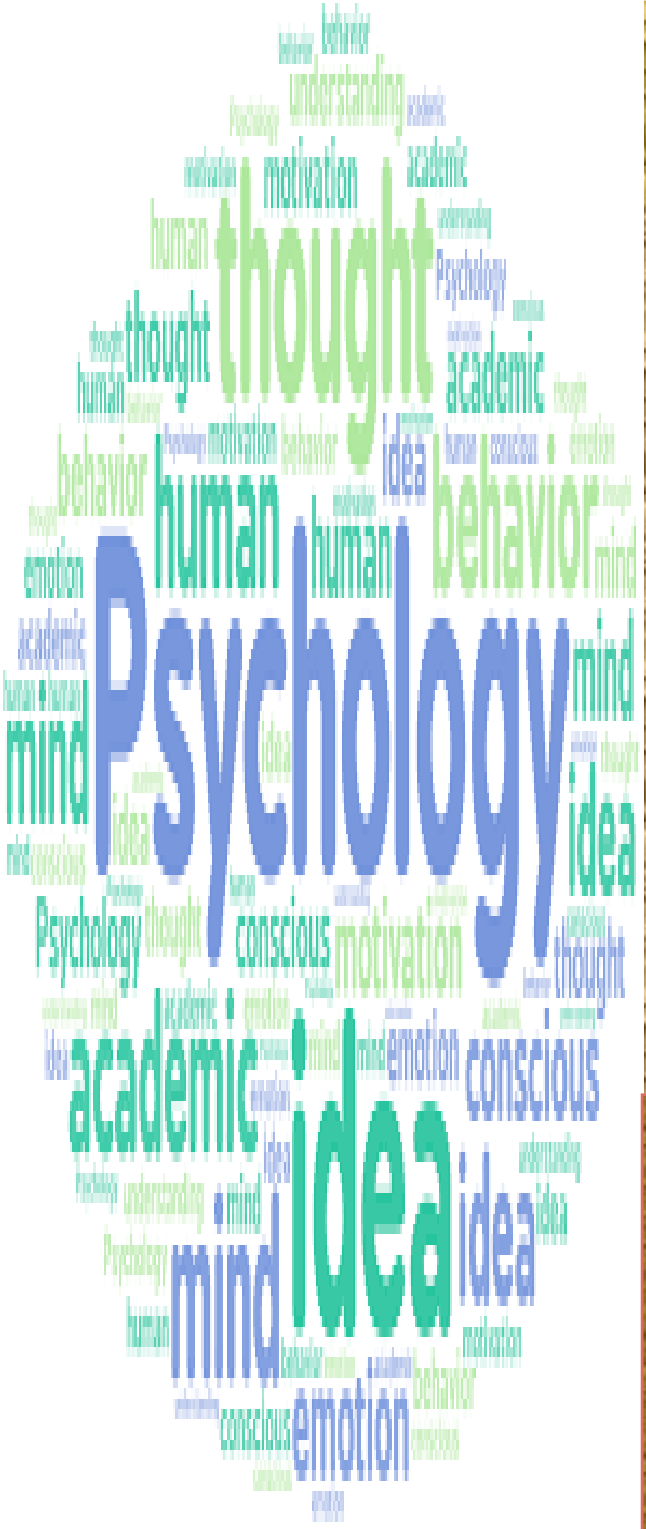
UNIT-5 Attention, Perception, Learning, Memory and Forgetting



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What is Attention: Forms of attention, Models of attention ?

Attention: Forms of attention, Models of attention

Understanding attention and its types are critical for improving our ability to live our lives efficiently. In order to fully master the attention mechanism, it is also necessary to learn both the external or internal factors that strengthen and affect it.

Attention can generally be defined as the ability to produce, select, manage and maintain sufficient stimulation at a specific amount of time to process any kind of information. It takes place on the cognitive level and has different types.

Attention is the key to achieve optimum functionality in our lives. The way to do this is to parse the factors or stimuli we encounter as relevant or irrelevant. Actually, this is when we make the most basic choices regarding the topics we are interested in or not.

Visual Attention

Generally speaking, visual attention is thought to operate as a two-stage process. In the first stage, attention is distributed uniformly over the external visual scene and the processing of information. In the second stage, attention is concentrated to a specific area of the visual scene; it is focused on a specific stimulus. There are two major models for understanding how visual attention operates, both of which are loose metaphors for the actual neural processes occurring.

Spotlight Model

The term “spotlight” was inspired by the work of William James, who described attention as having a focus, a margin, and a fringe. The focus is the central area that extracts “high-resolution” information from the visual scene where attention is directed. Surrounding the focus is the fringe of attention, which extracts information in a much more crude fashion. This fringe extends out to a specified area, and the cutoff is called the margin.

Zoom-Lens Model

First introduced in 1986, this model inherits all the properties of the spotlight model, but it has the added property of changing in size. This size-change mechanism was inspired by the zoom lens one might find on a camera, and any change in size can be described by a trade-off in the efficiency of processing. The zoom-lens of attention can be described in terms of an inverse trade-off between the size of focus and the efficiency of processing. Because attentional resources are assumed to be fixed, the larger the focus is, the slower processing will be of that region of the visual scene, since this fixed resource will be distributed over a larger area.

Cognitive Load

Think of a computer with limited memory storage: you can only give it so many tasks before it is unable to process more. Brains work on a similar principle, called the cognitive load theory. “Cognitive load” refers to the total amount of mental effort being used in working memory. Attention requires working memory; therefore devoting attention to something increases cognitive load.

Determining Factors That Influence the Functioning of Attention

As we mentioned before, attention is not a one-way process. There are a number of factors for a stimulus to attract our attention. Only a stimulus based on these factors triggers our cognitive functions and can initiate cognitive processing.

It is possible to examine these factors that attract our attention and maintain focus in two main groups:

1- Internal Factors

These determinants are personal because they depend on the individual's own cognitive resources and brain functions. Some of them can be listed as follows:

- Mental condition
- Needs
- Emotions
- Mindset
- Interests
- Motivation
- Physical state

2- External Factors

These determinants are usually based on the characteristics of the stimuli or come from our surroundings. Some of them can be listed as follows:

- Intensity
- Uniqueness
- Size
- Color
- Emotional Burden
- Contrast

The Four Types of Attention

There are several types of attention and they are shown in the chart below:

Selective Attention

When we focus our attention on anything, we actually choose to ignore many things. For example, imagine going to a bookstore. There is a specific book you want to buy and you are walking between the bookshelves to find that book.

Perhaps you are passing through hundreds of books without actually noticing any of them. On the other hand, your eyes actually see all of them and possibly record them deep into your mind, but you don't even realise it. This here is a great selective attention example.

Now that you have an understanding of the concept, let’s go over the selective attention definition.

If we need to define selective attention we can call it the process of focusing on a particular object in the environment for a certain period of time. Our attention is limited. So to use this limited

resource, we need selective attention, which allows us to ignore details that are not important.

How Does Selective Attention Work?

The term “cocktail party effect” is also used to describe selective attention psychology, especially in the Memory Selection Model. Because while we're at a party, there are many things that can distract us like music, light, and many other people talking. However, we can still focus on one conversation with a close friend. On the other hand, when our name is called among all the intense stimuli in this background, this will grab our attention.

So which of the following is the reason for human attention being selective?

It is proven that the capacity of our brains to take care of everything around us is very limited, so it is impossible for us to pay attention to each of these sensory experiences. Therefore, while our brain focuses our attention on some important elements of our environment, it puts all other stimuli in the background.

Theories of Selective Attention

In cognitive psychology, there is more than one selective attention theory, which is focused on when our brains react and interact with stimulating information from outside.

This model was defined by **Donald Broadbent in 1958**. He used a filtering metaphor of information processing to describe attention. Broadbent suggested that our filtering of information occurs early on in the **perceptual process**. Physical characteristics like colours,

loudness or direction of the stimulants processed before were used to select or reject a stimulus in later operations.

Resource Theories of Selective Attention

More recent theories suggest that human attention can interact with limited stimuli and tends to explain how these resources are divided among competing stimuli. Hence, source theories appear to be a much more effective metaphor to explain the phenomenon of attention divided into complex stimuli and tasks.

Visual Selective Attention

Perhaps we are exposed to millions of ads every day on the way to work or on the road. We don't even realize that we've seen many of these. But some, on the other hand, manage to attract our attention, especially if they address our current needs or taste. This shows that these advertisements have contacted with us as a stimulus by going through our selective perception.

Examples of Selective Attention

Cocktail Party Effect

As we've mentioned before, although there are many stimuli around in crowded and noisy environments such as parties, our brain selects certain stimuli and focuses on them.

Divided Attention

We use divided attention while simultaneously paying attention to two or more tasks. This ability is also called Multitasking. Divided attention uses mental focus on a very large scale. Nonetheless, this

does not allow the brain to fully focus on any task. Therefore, this type of attention does not last for long.

Alternating Attention

Alternating attention is the ability to change the focus of your attention and switch between different tasks. In this type of attention, mental flexibility is required so that one task does not limit the performance of others.

Sustained Attention

We often use sustained attention for tasks that take a long time or require intense focus. This type of attention allows one to consistently perform a certain mental activity. For example, when children study for an exam, they need to read and acquire the information in a textbook for several hours.

Differences Among the Types of Attention

	Selective Attention	**Divided Attention**
Focusing on Tasks	Unconsciously creating a mental focus on a	Placing mental focus on multiple tasks or ideas at once by giving some attention to each

	single task or idea at once while ignoring others	
Amount of Attention	Increases the amount of attention being directed to a task or idea because of a single focus taking place	Minimizes the amount of attention being placed on any task or idea if there are multiple focuses going on at once
Condition on	Successful tuning out	Unsuccessful tuning out of

Distractions & Switching tasks	of distractions and switching tasks.	distractions and switching tasks
Cognitive Ability	Strengthens cognitive ability	Weakens cognitive ability the most
Amount of Possible Mistakes	Reduces the rate of making mistakes	Drives to make mistakes
Receiving Side Information	Allows to miss important side information	Prevents missing important information

Now that you have discovered how your mind works, you should be ready for the improvement! Trying MentalUP, prepared by academicians and scientists especially to boost cognitive functions,

What is Perception: Approaches to the Study of Perception: Gestalt and physiological approaches

Perceptual Organization: Gestalt, Figure and Ground, Law of Organization Perceptual Constancy: Size, Shape, and Color; Illusions

Perception of Form, Depth and Movement Role of motivation and learning in perception?

Perception: Approaches to the Study of Perception: Gestalt and physiological approaches Perceptual Organization: Gestalt, Figure and Ground, Law of Organization Perceptual Constancy: Size, Shape, and Color; Illusions Perception of Form, Depth and Movement Role of motivation and learning in perception

Perception: Approaches to the Study of Perception: Gestalt and physiological approaches

While our sensory receptors are constantly collecting information from the environment, it is ultimately how we interpret that information that affects how we interact with the world. **Perception** refers to the way sensory information is organized, interpreted, and consciously experienced. Perception involves both bottom-up and top-down processing. **Bottom-up processing** refers to the fact that perceptions are built from sensory input. On the other hand, how we interpret those sensations is influenced by our available knowledge, our experiences, and our thoughts. This is called **top-down processing**.

One way to think of this concept is that sensation is a physical process, whereas perception is psychological. For example, upon walking into a kitchen and smelling the scent of baking cinnamon rolls, the sensation is the scent receptors detecting the odor of cinnamon, but the perception may be "Mmm, this smells like the bread Grandma used to bake when the family gathered for holidays."

Although our perceptions are built from sensations, not all sensations result in perception. In fact, we often don't perceive stimuli that remain relatively constant over prolonged periods of time. This is known as **sensory adaptation**. Imagine entering a classroom with an old analog clock. Upon first entering the room, you can hear the ticking of the clock; as you begin to engage in conversation with classmates or listen to your professor greet the class, you are no longer aware of the ticking. The clock is still ticking, and that information is still affecting sensory receptors of the auditory system. The fact that you no longer perceive the sound demonstrates sensory adaptation and shows that while closely associated, sensation and perception are different.

In the beginning of the nineteenth century, two vastly developed areas in psychology, viz. perception and ' personality came nearer to each other. Numerous researches were carried out to study the relation between perception and personality. Perceptual characteristics have some sort of relation with individual's personality organization. Various journals have published findings of perception personality relationship. While going through this literature, one can find that the relation between perception and personality was studied from different angles. In other words, there are various approaches for studying the relation between-these two important fields which have systematically, scientifically and experimentally developed . in the last fifty years.

Topological Approach :

As early as 1944, Thurstone described an extensive ' factorial exploration of various perceptual tasks in order to isolate underlying variables which could be used to account for individual differences. Since that time,tll©£§ have been many attempts to relate various personality variables to differences in performance on perceptual tasks.

Innumerable perceptual tasks have been studied, and significant correlations have frequently been reported. For example, to mention only a few studies, Johansson^8®^ in a study of motion perception and personality,

constructed perceptual measures based on the fact that a perceived velocity of a single object moving in a visual field increases considerably when a second object moving with the same speed in the opposite direction is introduced Ss with ns .

extreemly slow ’velocity synthesis' (affected little by the A relativity effect introduced by the other object in the ally motion percept) were found to be artistic withdrawn, and to possess self-isolating attitudes. Schumer -^found marked differences in the quality of phi-phenomenon experiences reported by 100 college men. These differences were found to be significantly related to productivity of human movement in the Rorchach.

extensive factor analysis which’ included 29 simple perceptual measures, such as visual acuity and simple closure, and more L complex measures such as after-images, t^chistoscopic performance and various automatic tests. The perceptual tasks, as well as a questionnaire which was used, held up well, that is, normal, neurotics and psychotics were differentiated. The author's hypothesis that normality was associated with 'integrative', 'wholistic', 'synthetic' attitudes was, according to them, generally confirmed. Vandenberg reanalyzing some of Eysenck's results, generally confirmed his findings. It seems strange, however, that in these studies, insufficient attention was paid to the questions of set, attention and motivation which plagued workers in psychopathology.

The Work of Erenkel-Brunswik

E.F. Brunswik's approach to perception is still another example of perceptual research which is almost entirely personality oriented and which throws light on personality factors as well as social and emotional variables. Brunswik became interested in perceptual variables in connection with the well-known research at the Institute of Child Welfare of the^ University of California which dealt with prejudiced and nonprejudiced attitudes and their motivational and cognitive correlates. Generally speaking, ethnocentric attitudes

were found to be related to authoritarian personality structure. Brunswik soon discovered that many of'her Ss were less able to tolerate 'emotional ambiguities' than others. She became interested, in whether or not this intolerance extended also to the more traditional field of perception. As a result of some of her explanations, she was able to offer rich evidence on the basis of interviews, clinical evaluations etc.

Directive State Approach :

In the late 1940's, a 'new look' in perceptual theory emerged. The approach of the workers doing the early studies within this framework can be regarded as the single most , important influence in the swing towards the belief that perception is essentially a personality oriehted phenomenon. There were innumerable reports of research, some'opposing, some defending the conclusions of the original classic and studies; bitterness, criticalness, and deep conviction pervaded the literature.

The'new look'-is a phrase borrowed from' the publicity releases from liaison Dior in Paris, which described some startling changes in fashion. The great discovery of the 'new look* Was that the perceiver also counts. In somejways, the introduction of the perceiver into the process of perception can be linked to the introduction of the observer into the measurement of velocity in the theory of relativity.

Einstein's great contribution emerges when-he introduced the velocity of the observer or his frame of reference into the measurement of the velocity of an object. In the same way, the new look hoped to revolutionize » perception by introducing the characteristics of the perceiver, that ,is, his personality (drives,

needs etc.). Unfortunately, the revolution in psychology did not go off as successfully as the revolution in physics, but fizzled more like the revolution in fashion.

Directive State Theory (Approach) - The Controversy, Re-evaluation Approach :

McCinnies' study (^2) which reported inereasedthresbolds for recognition of emotionally toned, taboo words, was regarded as strongly supportive of perceptual defence, as a special mechanism. This specific study stimulated much controversy. Howes and Soloman (74,75) advanced the notion that McG-innies' results could be explained in other ways.

They noted that M&Ginnies' taboo words were much less familiaf than the neutral words. They demonstrated that the more familiar a word was, the brifer was its recognition thresholds; (perceptual defence) for S f \ the taboo words, although McGinnies defended his original interpretation. In general, the concept of perceptual defence began the to lose status, even among directive state workers themselves. McGinnigs' v defence consisted of noting that increased recognition thresholds for neutral words were found when they followed immediately after taboo words - constituting evidence for 'generalization' of the-avoidance (defensive) reaction. furthermore, the analysis of pre-recognition responses suggested that for neutral words there was a greater resemblance to the stimulus words than there' was for the (122) taboo words. Postman, Bronson and Gropper strongly the contested these explanations, suggesting that uncontrolled variations in familiarity of words could account for most of the perceptual defence effect. Solomon and Postman^155^ had already reported a study which showed that

recognition thresholds varied inversely with frequency of past y; usage.

Following are the additional points to he noted.

(1) Although many correlations between needs and perception have been demonstrated, there is a general failure to explain how and why these take place, that is, the mediation factors are not clear.

(2) In many studies which have purporated to show the relationship of need perception, cognitive and judgmental elements are used as measures of perceptual response. These studies have failed to distinguish between perception and judgment. If motivational states influence perception per se, this should probably be demonstrated in experimental designs which control for factors such as attitude, set, memory, attention and familiarity.

(3) Most of the effects have been demonstrated with P maginalj ambiguous stimulus . Are needs and motivations as powerful and influential in 'everyday' veridical perception as they are under marginal stimulus conditions ?

(4) Perceptual modifications as a result of motivational states should be demonstrated through immediate perception, rather than in more complex, cognitive, and social situations.

(5) Effects demonstrating the relation between perception and need should probably be studied not only with other means, but with other experimental procedures and other perceptual events and situations.

Hypothesis or Expectancy Theory (Approach) ;

The directive state approach face some methodological problems and from that a theory of hypothesis or expectancy was developed. This approach suggests that perceiving is always based on an expectancy or hypothesis on the part of the organism, /V' that is, he is turmed to some aspects of his surroundings.(This view of perceiving is of course related to the approach of various set theories.)Bruner and Postman ^ Krere the original founders of the hypothesis or expectancy theory. Perception involves the input of information from the environment. Input is not specified in terms of stimulus energy, hut rather in terms of its signal value, as cue or clue. The next process involves the checking or confirmation of the is organism's hypothesis. Iff thereA confirmation, the hypothesis is strengthened and its arousal will he 'easier' in future when similar 'information' from the environment is received. If the hypothesis is not confirmed, the organism will introduce a new hypothesis, until one of them is confirmed.

Individual Differences jka revealed in Perceptual Behaviour !

The presence of individual differences in perceptual behaviour was recognised in psychology. Psychologists interested in the field of perception and sensory processes have characteristically taken considerable pains to devise experimental situations that are sufficiently simple and controlled to minimize these individual differences,

in the interest of studying more accurately the phenomena with which they are'primarily concerned. Any way, little attempt was made to study individual differences in perception systematically in relation to other aspects of behaviour or personality.

Thurstone's ex-t;ensiVe factor analysis of perceptual task was predominantly oriented towards isolating or detecting general factors of perception, but was not particularly concerned with personality correlates of these perceptual factors, There were no personality'tests included in the battery that would have made such relationships detectable.

Early investigators used Rorchach ink-blot to relate systematically personality t traits and perception. Early in the modern revival of interest in experimentation (84,82) on need in perception,

Klein- has drawn attention to the presence of perceptual styles and perceptual modes of handling (82) threatening or emotional material. Klein and his associates have gone on to show the presence of a personality dimension labeled 'leveling1 (versus sharpening) which is revealed not only in perceptual recognition behaviour, but in perceptual judgmental tasks as well.

Gestalt psychology

school of psychology founded in the 20th century that provided the foundation for the modern study of perception. Gestalt theory emphasizes that the whole of anything is greater than its parts. That is, the attributes of the whole are not deducible from analysis of the parts in isolation.

The word Gestalt is used in modern German to mean the way a thing has been "placed," or "put together." There is no exact equivalent in English. "Form" and "shape" are the usual translations; in psychology the word is often interpreted as "pattern" or "configuration."

Gestalt theory originated in Austria and Germany as a reaction against the associationist and structural schools' atomistic orientation (an approach which fragmented experience into distinct and unrelated elements). Gestalt studies made use instead of phenomenology. This method, with a tradition going back to Johann Wolfgang von Goethe, involves nothing more than the description of direct psychological experience, with no restrictions on what is permissible in the description. Gestalt psychology was in part an attempt to add a humanistic dimension to what was considered a sterile approach to the scientific study of mental life. Gestalt psychology further sought to encompass the qualities of form, meaning, and value that prevailing psychologists had either ignored or presumed to fall outside the boundaries of science.

The publication of Czech-born psychologist Max Wertheimer's "Experimentelle Studien über das Sehen von Bewegung" ("Experimental Studies of the Perception of Movement") in 1912 marks the founding of the Gestalt school. In it Wertheimer reported the result of a study on apparent movement conducted in Frankfurt am Main, Germany, with psychologists Wolfgang Köhler and Kurt Koffka. Together, these three formed the core of the Gestalt school for the next few decades. (By the mid-1930s all had become professors in the United States.)

Perceptual Organization: Gestalt, Figure and Ground, Law of Organization

Have you noticed how a series of flashing lights often appears to be moving, such as neon signs or strands of lights? According to Gestalt psychology, this apparent movement happens because

our minds fill in missing information. This belief that the whole is greater than the sum of the individual parts led to the discovery of several different phenomena that occur during perception.[1]

The law of closure is one example of a Gestalt law of perceptual organization. According to this principle, things in the environment often tend to be seen as part of a whole. In many cases, our minds will even fill in the missing information to create cohesive shapes.

A Brief History of the Gestalt Laws

Gestalt psychology was founded by German thinkers Max Wertheimer, Wolfgang Kohler, and Kurt Koffka and focused on how people interpret the world.[2] The Gestalt perspective formed partially as a response to the structuralism of Wilhelm Wundt, who focused on breaking down mental events and experiences to the smallest elements.

Max Wertheimer noted that rapid sequences of perceptual events, such as rows of flashing lights, create the illusion of motion even when there is none. This is known as the phi phenomenon. Motion pictures are based on this principle, with a series of still images appearing in rapid succession to form a seamless visual experience.

According to Gestalt psychology, the whole is different from the sum of its parts. Based upon this belief, Gestalt psychologists developed a set of principles to explain perceptual organization, or how smaller objects are grouped to form larger ones.

These principles are often referred to as the "laws of perceptual organization." However, it is important to note that while Gestalt psychologists call these phenomena "laws," a more accurate term

would be "principles of perceptual organization." These principles are much like heuristics, which are mental shortcuts for solving problems.

Follow the links below to find more information and examples of the different Gestalt laws of perceptual organization.

Gestalt theory [1] has provided perceptual science with a conceptual framework relating to brain mechanisms that determine the way we see the visual world. This is referred to as "Perceptual Organization" and has inspired researchers in Psychology, Neuroscience and Computational Design ever since. The major Gestalt principles, such as the principle of Prägnanz, and more importantly the Gestalt laws of perceptual organization, have been critically important to our understanding of visual information processing, how the brain detects order in what we see, and derives likely perceptual representations from statistically significant structural regularities. The perceptual integration of contrast information across co-linear space for the organization of objects in the 2D image plane into figure and ground convey the most elementary basis to our understanding of the visual world. Gestalt theory continues to generate powerful concepts and insights for perceptual science even today, where it is to be placed in the context of image-base decision making by human minds and machines.

However, in complex images, some visible stimulus fragments appear clearly aligned, others do not. Specific phenomenal conditions need to be satisfied to enable collinear interpolation in static 2D scenes, and the process of interpolation constrains the spreading of surfaces across unspecified regions in the image

[45,46]. Also, not all of perceptual organization is hardwired [47,48], and the contribution of past experience and perceptual learning to early mechanisms of perceptual integration needs to be taken into account given that specific memory data about objects and their most likely spatial configuration may facilitate or interfere with, depending on conditions, ongoing visual processing of ambiguous image data. The question relative to recovery of 'veridical' object properties from image data may be seen as a byproduct of perceptual organization, but was not an issue raised by Gestalt theory. However, the laws of perceptual organization have generated a conceptual framework for addressing this problem space in a bottom-up approach. The 'veridicality' of perceptual representations our brain may derive from visual stimuli raises deeper philosophical questions. Perceptual organization as such may be seen as resulting from pressure on the perceptual system to actively construct ordered representations of objects in depth in response to intrinsically ambiguous visual data. The biological role of perceptual organization, placed in the context of evolution, would be to ensure behavioral adaptation and success. Perceptual organization becomes mandatory as soon as the visual signals contained in an image or a scene reach our retina [49]. The major part of the necessary information processing then takes place in the visual brain, involving a whole chain of mechanisms well beyond the retina. Perceptual neuroscience has provided us with a diversified account for the many ways in which visual sensitivity to ordered structure and regularities expresses itself in behavior on the basis of cortical mechanisms. Multiple stages of neural processing transform fragmented signals into visual key representations of 3D scenes that can be used to control effective behavior. Since our survival depends on our ability to pick up order in the physical world, and

since we conceive the physical world as an ordered one, our brain must be sensitive to structural regularities in the physical world. Neural interactions “beyond the classic receptive field” drive the visual processing of texture dissimilarities, boundary completion, surface filling-in, and figure-ground segregation in the brain genesis of “perceptual order”.

Figure-Ground Perception in Psychology

Figure-ground perception refers to the tendency of the visual system to simplify a scene into the main object that we are looking at (the figure) and everything else that forms the background (or ground). The concept of figure-ground perception is often illustrated with the classic "faces or vases" illusion, also known as the Rubin vase. Depending on whether you see the black or the white as the figure, you may see either two faces in profile (meaning you perceive the dark color as the figure) or a vase in the center (meaning you see the white color as the figure).

A History of Figure-Ground Perception

The concept of figure-ground perception emerged out of the field of Gestalt psychology. According to the Gestalt approach, the whole is more (or different) than the sum of its parts.[1] The term Gestalt itself comes from the German word meaning "form" or "shape."

During the 1920s, a number of German psychologists including Max Wertheimer and Wolfgang Kohler began studying different principles of perception that govern how people make sense of an often disorderly world. Their work led to what is known as the Gestalt laws of perceptual organization.

The Gestalt theory of perception proposes that people make sense of the world around them by talking separate and distinct elements and combining them into a unified whole.[2]

For example, if you look at shapes drawn on a piece of paper, your mind will likely group the shapes in terms of things such as similarity or proximity. Objects that are similar to one another tend to be grouped together. Objects that are near each other also tend to be grouped together.

While the concept of figure-ground perception is an important principle in Gestalt psychology, it is usually not identified as one of the laws of perceptual organization.

People Distinguish Between Figure and Ground?

When looking at a visual scene, people tend to look for ways to differentiate between the figure and the ground. Some ways that people accomplish this include:[1]

- **Blurriness:** Objects in the foreground tend to be crisp and distinct while those in the background are blurry or hazy.
- **Contrast:** The high contrast between objects can lead to the perception of figure and ground. The Rubin vase is one example.
- **Size:** Images that appear to be larger will be perceived as closer and part of the figure while those that are smaller will seem further away and part of the background.
- **Separation:** An object isolated from everything else in a visual scene is more likely to be seen as a figure versus background.

Examples

The "faces or vases" illustration is one of the most frequent demonstrations of figure-ground. What you see when you look at the faces or vases illusion depends on whether you see the white as the figure or the black as the figure.

If you see the white as the figure, then you perceive a vase. If you see the black as the figure, then you see two faces in profile.

Perceptual Constancy: Size, Shape, and Color; Illusions

Perceptual constancy is perceiving objects as having constant shape, size, and color regardless of changes in perspective, distance, and lighting.

KEY POINTS

- Perceptual constancy refers to perceiving familiar objects as having standard shape, size, color, and location regardless of changes in the angle of perspective, distance, and lighting.
- Size constancy is when people's perception of a particular object's size does not change regardless of changes in distance from the object, even though distance affects the size of the object as it is projected onto the retina.
- Shape constancy is when people's perception of the shape of an object does not change regardless of changes to the object's orientation.

- Distance constancy refers to the relationship between apparent distance and physical distance: it can cause us to perceive things as closer or farther away than they actually are.
- Color constancy is a feature of the human color perception system that ensures that the color of an object is perceived as similar even under varying conditions.
- Auditory constancy is a phenomenon in music, allowing us to perceive the same instrument over differing pitches, volumes, and timbres, as well as in speech perception, when we perceive the same words regardless of who is speaking them.

Visual Perceptual Constancies

There are many common visual and perceptual constancies that we experience during the perception process.

Size Constancy

Within a certain range, people's perception of a particular object's size will not change, regardless of changes in distance or size change on the retina. The perception of the image is still based upon the actual size of the perceptual characteristics. The visual perception of size constancy has given rise to many optical illusions.

The Ponzo illusion

This famous optical illusion uses size constancy to trick us into thinking the top yellow line is longer than the bottom; they are actually the exact same length.

Shape Constancy

Regardless of changes to an object's orientation, the shape of the object as it is perceived is constant. Or, perhaps more accurately, the actual shape of the object is sensed by the eye as changing but then perceived by the brain as the same. This happens when we watch a door open: the actual image on our retinas is different each time the door swings in either direction, but we perceive it as being the same door made of the same shapes.

Shape constancy

This form of perceptual constancy allows us to perceive that the door is made of the same shapes despite different images being delivered to our retinae.

Distance Constancy

This refers to the relationship between apparent distance and physical distance. An example of this illusion in daily life is the moon. When it is near the horizon, it is perceived as closer to Earth than when it is directly overhead.

Color Constancy

This is a feature of the human color perception system that ensures that the color of an object remains similar under varying conditions. Consider the shade illusion: our perception of how colors are affected by bright light versus shade causes us to perceive the two

squares as different colors. In fact, they are the same exact shade of gray.

Auditory Perceptual Constancies

Our eyes aren't the only sensory organs that "trick" us into perceptual constancy. Our ears do the job as well. In music, we can identify a guitar as a guitar throughout a song, even when its timbre, pitch, loudness, or environment change. In speech perception, vowels and consonants are perceived as constant even if they sound very different due to the speaker's age, sex, or dialect. For example, the word "apple" sounds very different when a two year-old boy and a 30 year-old woman say it, because their voices are at different frequencies and their mouths form the word differently... but we perceive the sounds to be the same. This is thanks to auditory perceptual constancy!

Perceptual illusion

While the problem of perceptual illusion has not aroused quite the same degree of empirical or theoretical interest among neurophysiologists as among experimental psychologists there has nevertheless been a continuing concern with the neural correlates of illusory phenomena. Both Motokawa1 and Burns and Pritchard2 have recently attempted to establish the neural interactions associated with these distortions. However, the problem has proved extraordinarily intractable and the neural structures and processes associated with illusory effects remain quite obscure.

Visual size constancy and illusion

As the observer recedes from an object (or vice versa) the retinal image of the latter diminishes but its apparent size is relatively

constant. Therefore information for distance must be involved in the maintenance of constant apparent size. That this is so was made clear in the classic experiments of Holway and Borings in which distance stimuli were progressively reduced. Since then data from three separate experiments9 " 11 have shown that when distance stimuli are entirely eliminated an object's apparent size decreases as a linear function of observer-object-distance, i.e., apparent size follows the "law of the visual angle." "Cues" or stimuli for distance fall into five classes:

(1) retinal disparity (or binocular parallax;

(2) muscular stimuli (convergence and accommodation);

(3) monocular parallax;

(4) atmospheric stimuli (aerial perspective and the Tyndall effect); and

(5) projected stimuli (perspective, texture, overlay, elevation in field, element and interspace size, and element and interspace frequency. Normally all or most of these stimuli for distance are present and visual size constancy is perfect. However, although size constancy falls off as distance stimuli are systematically reduced (e.g., when binocular parallax is eliminated by using one eye and monocular parallax by holding the head stationary8) some degree of constancy obtains, i.e., apparent size does not follow the law of the visual angle, as observer-object distance increases.

Geometric size illusions

The projected stimuli for distance, stimuli which derive essentially from the projection of a three-dimensional space on to the two-

dimensional retinal surface, are more frequent and subtle than is usually realized. In addition to the well-known stimuli such as perspective, texture, overlay, and elevation, the size and frequency of elements other than the focal object and the size and frequency of interspaces between them vary with distance and provide information for distance. The trees on the near side of a lake are bigger and fewer per unit visual angle than the smaller and more frequent trees on the far side, as indeed are the interspaces between them. Many geometric optical illusions involve such distance stimuli.

Of two objects one is usually located in the context of larger and less frequent elements or spaces consonant with nearness and the other in the context of smaller and more frequent elements corresponding to greater distance. The former object is judged smaller than the latter.

The Oppel-Kundt, Delboeuf, and Miiller-Lyer illusions are examples of size illusions in which the retinal image of an object, usually a line or simple figure, is invariant but projected stimuli for distance are varied. It should be noted, however, that as had been pointed out elsewhere15 the Miiller-Lyer illusion as it is classically sbown represents two separate effects. The "short" version with "inboard" elements is probably a different illusion than the "long" version with "outboard" elements. Evidence for this difference has been adduced by Erlebacher and Sekuler.

Visual orientation constancy and illusion When the observer's head is tilted laterally as posture is changed, the retinal orientation of the object's image relative to the normally vertical meridian of the eye changes. When the observer is recumbent this change is nearly 90

degrees. However, under conditions of normal illumination and when only the object itself is visible in a dark room, its apparent tilt is relatively stable, a phenomena called visual orientation constancy.17 In normal illumination the bar remains perceptually invariant even for large lateral body tilts.

Perception of Form, Depth and Movement

Form Perception

The **Gestalt Psychologists** studied extensively **form perception**, or the perception of objects, shapes and patterns. Gestalt principles may be broken down into two categories: **perceptual organization (grouping)** and **depth perception**.

Gestalt Principles of Perceptual Organization

- **How objects are grouped together** (Links to an external site.)
    - **Continuity**
        - We tend to perceive figures or objects as belonging together if they appear to form a continuous pattern
    - **Closure** (**Connectedness**)
        - We perceive figures with gaps in them to be complete
    - **Similarity**
        - We perceive figures which look alike as being grouped together

- **Proximity**
  - We perceive things close together as being in sets
- **Pragnanz**
  - We perceive reality in the simplest way rather than inferring complexity

Take a minute to take some notes: How are Gestalt grouping principles used in The Human Condition (above)

Monocular depth cues

- **Depth cues that can be perceived by only one eye**
  - **Interposition**
    - When one object partly blocks your view of another, you perceive the partially blocked object as farther away
  - **Linear perspective**
    - Parallel lines that are known to be the same distance apart appear to grow closer together, or converge, as they recede into the distance
  - **Relative size**
    - Larger objects are perceived as being closer to the viewer, and smaller objects as being farther away
  - **Texture gradient**
    - Near objects appear to have sharply defined textures, while similar objects appear progressively

smoother and fuzzier as they recede into the distance

- **Atmospheric perspective**
  - Objects in the distance have a bluish tint and appear more blurred than objects closer to the viewer

Take a minute to take some notes: How are depth cues used in The Human Condition (above)

Gestalt principles help explain how we perceive distance, depth, organization and harmony on a 2 dimensional canvas.

Visual Perception in a nutshell – our visual perceptual system works to heighten differences and impose constancies to help us survive in the big, scary world, often causing disparities between what we see and the physical world.

Or, as Aristotle succinctly put it: "**our senses can be trusted but they can be easily fooled.**"

For example, in the image below both of the orange (middle) circles are exactly the same size. This one of many visual illusions, called the **Ebbinghaus Illusion**, which explore the effect of context on perception. Our visual system compares the circles and exaggerates the differences between them.

Our visual systems allow us to resolve fine detail, track a moving object, perceive depth, and see colors. Somehow, all these components of a visual scene merge so that we have one visual

experience; for example, when we see a cat playing with a string, we interpret the scene-paws striking the string, details of claws and whiskers, the cat's paw in front of or behind the string, the colors of the cat-as a unitary visual event, even though we can attend to one or the other of these individually. How do our brains deal with such complex visual information? First, we will consider theories on the processing of motion, form, and color; then we will discuss binocular vision and perceiving depth.

One possibility for how we perceive a visual scene is that a defined series of neurons and their axons handles all information-motion, shape, and color-from a part of the visual field in a hierarchical manner. That is, a defined set of photoreceptors, other retinal cells, lateral geniculate cells, and cortical cells acts as a serial pathway for information from a block of the visual scene.

This information arrives at a "master" cell or group of cells, in a visual association area of the cortex, which combines the current information with memories of previous experiences and make sense of it. In this model, pieces of the visual scene are transmitted like sections of a photograph to the brain.

However, evidence does not support this "photographic transmission" or serial pathway theory, but rather a parallel pathways model. This model states that three primary types of information-color, shape, and motion-are individually "pulled out" of the visual scene and sent through three parallel pathways, beginning right in the retina. In this view, one cone receptor receives light from a small area, for example, on the face of a moving calico cat, and signals from this cone go to several intermediate retinal cells and from these to ganglion cells.

Each of the ganglion cells responds to only one of the attributes-color, form, or motion-of the cat's face. The ganglion cells forward their signals to lateral geniculate nucleus (LGN) cells in the thalamus that respond uniquely to that one type of information (color, form, or motion), and so on to the primary visual cortex and further cortical areas. At higher areas, the scene is put back together again, as discussed below.

Higher cortical areas reassemble the visual puzzle

Although parallel visual processing seems to fragment what we see, at higher levels the puzzle is reassembled. Further, the immediate visual scene is then interpreted in light of what we know from past visual experiences and what the wiring of our brains allows. While our visual experiences usually make sense to us, we are generally unaware of the cues we are using to interpret scenes until we are challenged with unconventional pictures such as illusions. For example, when we see a friend at some distance, we recognize the person and know that this is a normal adult (or child) even though the image on the retina is much smaller than that of a person standing right next to us.

Perceiving depth depends on both monocular and binocular cues

Along with information on motion, shape, and color, our brains receive input that indicates both depth, the perception that different objects are different distances from us, and the related concept of stereopsis, the solidity of objects. Studies show that people have two ways of judging depth or distance: using monocular (one-eyed) information, and using binocular (two-eyed) data. Monocular cues

operate at distances of around 100 feet or greater, where the retinal images seen by both eyes are almost identical. These cues include:

1. Previous familiarity: If we know the range of sizes of people, cats, or trees, we can judge how far away they are.
2. Occlusion: If one object partly hides another, we know that the object in front is closer.
3. Perspective: Parallel lines such as the edges of a road, the intersections of walls and ceilings, and railroad tracks, appear to converge at a distance. The relative distances between objects in a scene with parallel lines are estimated by their positions along the converging lines.
4. Motion parallax: As we move our heads or bodies, nearby objects appear to move more quickly than distant objects; for example, telephone poles beside the road appear to pass by much more quickly when viewed from a moving car than do buildings or trees hundreds of feet back from the road.
5. Shadows and light: Patterns of light and dark can give an impression of depth, and bright colors tend to seem closer than dull colors.

Even though these monocular cues provide some depth vision so that the world does not look "flat" to us when we use just one eye, viewing a scene with two eyes-binocular vision-gives most people a more vivid sense of depth and of stereopsis. This is important when viewing objects closer than about 100 feet. Stereoscopic (three-dimensional) vision depends on the fact that the eyes are separated, on average, by about six centimeters, and thus get slightly different views of the same object. This means that when we

fixate an object (place its image on the fovea), we can tell if another object is in front of or behind it by the difference in location of the second object's image on the two retinas. This difference in retinal position is called retinal disparity (Figure 3.) and is essential for stereoscopic vision. Experiments have shown that depth perception occurs at the level of the primary visual cortex or perhaps higher (association cortex), where individual neurons receiving input from the two retinas fire specifically when retinal disparity exists. Although scientists have located such neurons and know they are important for merging or fusing the images from the two eyes, they cannot yet fully explain how the brain accomplishes this.

We first scan a scene, and then we attend to individual features

Finally, what we see depends on what we pay attention to. Sometimes the nature of the visual scene is such that one object or feature "pops out" at us because of distinctive boundaries. If the elements of a scene are not different enough from each other, no one part gets our attention over another. Vision scientists describe two sequential processes that direct our attention: the first is a rapid scanning system that tells us if a simple property is different in one or more parts of a scene. After the initial scan, we direct our attention to individual features of the scene-color, shape, orientation, size-and compare each part with others to detect subtle differences, or we compare each with a previously known version of the scene or object. Our ability to recognize any differences in what appear initially to be two identical objects, or sets of objects, depends on several factors, such as the degree of differences and previous familiarity with the objects.

One illustration of how we can miss differences in scenes when we first rapidly scan them is to make a copy of a photograph of a well-known person and to carefully alter one or two aspects of the picture: make the eyebrows heavier, change the mouth, add bags under the eyes. When the original and the altered copies are viewed side by side and upside down, the changes can be very difficult to identify. If these two pictures are viewed upright, the differences are immediately apparent. Another way to illustrate visual attention is to make a pattern of identical marks or simple objects, such as a sheet of paper with row upon row of X's, with one row containing one or two Z's. See how long it takes to identify the odd letters or objects. Students can devise tests like these in the experimental part of this unit.

Role of motivation and learning in perception

In this research, we have examined the characteristics of university students' motivation and its connection with perceptions of the learning environment. Higher education teachers often find it challenging to decide how to organize their lectures and what instructional strategy they should use to be most effective. Therefore, we endeavoured to determine which characteristics of the learning environment best predict the motivational orientation of students and their satisfaction with the course.

The survey included 120 postgraduate students of the Faculty of Arts at the University of Ljubljana. In order to measure their motivation, we employed several scales of the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991). For the purpose of this research, we created a new questionnaire for their evaluation of

the learning environment. The results revealed a high correlation between the intrinsic goal orientation, self-efficacy, and control beliefs. The most important factors of the learning environment that are connected with the formation of intrinsic goal-orientation and the enjoyment of education are the perception of the usefulness of the studied topics, a feeling of autonomy, and teacher support.

To an extent, these findings are supported by the findings of those authors who recommend using those methods of teaching that are in compliance with the student-centred understanding of teaching and learning.

In the previous two decades, the research conducted on achievement goals and achievement goal orientations has become highly prominent in the field of education (e.g. Ames, 1992; Dweck, 1986; Nicholls, 1984; Urdan, 2004). Moreover, certain meta-analyses have shown that this field has become predominant in the research of motivation (Austin & Vancouver, 1996). In psychology, goals are understood as the subject, activity or phenomenon at which our action is directed and with which we satisfy our need (Locke & Latham, 1990),

whilst achievement goal orientations are the individuals' general approaches or schemes with which they undertake tasks and evaluate their achievements (Kaplan & Maehr, 2007; Pintrich & Schunk, 2002; Urdan, 2004).

Previous research has shown that, in order to understand the students' approach to studying, it is crucial to know the reasons for their dealing with a particular task and the goals they set for themselves in the process. In this context, the authors predominantly differentiate between mastery goals (i.e. intrinsic

goals for which the emphasis is placed on the development of competence) and performance goals (i.e. extrinsic goals that place an emphasis on achievements and comparisons with others).

The positive effects of intrinsic goals have been demonstrated in research on a number of occasions. They express themselves in higher diligence and assiduity in performing the task (Elliot & Church, 1997; Elliot & McGregor, 1999; Middleton & Midgley, 1997), increased self-efficacy (Pajares, 1997), and using advanced learning strategies (Archer, 1994).

The negative consequences of extrinsic goals are mostly reflected in the use of superficial learning strategies (Elliot et al., 1999), increased perception of stress (Smith, Sinclair, & Chapman, 2002), and self-handicapping (Urdan, 2004).

Achievement goal orientations A review of literature reveals that the research of achievement goals orientations derives predominantly from the work of Nicholls (1984) and Dweck (Dweck, 1985; Elliott & Dweck, 1988). They define motivation as achieving goals, which refer to increasing competences and assessing competence, whilst also defining goals as purposes, which explains why an individual undertakes a particular activity.

Nicholls (1984) was primarily researching how people define success in performance situations, and established that an individual can compare their achievement with their own progress, either self-reflectively (e.g. “I have learned something new”, “I have performed better than the last time”) or by applying some normative criterion (e.g. “I have performed better than others have”).

Although Nicholls pointed out the importance of the situation in setting goals, he principally focused on establishing interpersonal differences in setting goals or motivational orientations. Being task-involved or being egoinvolved expresses differences in aspirations in achieving these performance criteria.

These two orientations are supposed to be related to the perception of reasons for success, learning approaches, school evaluation and so on. Explicit differentiation between increasing competences and assessing competence is what led Dweck and Nicholls to define more precisely the two main types of performance goals: the goals that place an emphasis on management and the goals that place an emphasis on achievements.

The learning environment

The term “learning environment” most frequently defines the social, psychological, or psychosocial environment in which learning or, as the case may be, teaching takes place (Cleveland & Fisher, 2014). For the most part, research has focused on the different elements of classroom context. Bronfenbrenner (1979) defines the classroom context as a microsystem, “a pattern of activities, roles and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics” (Bronfenbrenner, 1979, p. 22), i.e. it contains elements that contribute to the understanding of the happenings in the classroom.

The belief that students and teachers should be researched as a whole prevailed, but researchers have shown a tendency to isolate individual variables instead of attempting to understand the complex integration of thinking, motivation, and feelings. The authors found that teaching never directly affects learning; on the contrary, it

operates through intermediary factors that include perceptions of teaching, evaluation, the climate in the classroom, the content of the school subject, structure and similar.

Research has shown that the student's assessment of teaching characteristics or classroom learning environment influences a number of cognitive and affective results (Fraser, 1989; Fraser & Fisher, 1982; Walberg, 1969). In their meta-analysis, Wang et al. (1990) established that the learning environment is one of the most important factors of learning, which affects both motivation for learning and learning achievements (Wang, Haertel, & Walberg, 1990).

Purpose of the present study

To date, research on the influence of learning context on the formation of goal orientations and other factors of learning motivation has primarily focused on classroom settings, specifically on the characteristics of teaching tasks, assessment, and instructional strategies. We believe that goal orientation is among the most important factors of motivation.

The first and most important reason is that goal orientation directly influences many important aspects of student motivation. For example, it is more likely that students with intrinsic goal orientation will have higher self-efficacy, use more complex cognitive learning strategies, be meta-cognitively more active, and achieve better learning outcomes. Previous research shows that goals direct, or at least mediate, the entire process of self-regulation of learning, wherein the use of strategies is only one of the aspects.

Method

Participants and procedure The survey was conducted between November and December 2014, and included students who were enrolled in the first year of master studies at the Faculty of Arts at the University of Ljubljana. The sample consisted of 120 students (102 female, 17 male, 1 did not reveal his or her gender) who study in different programs, but are also participating in the common teaching module. This means that than 80% of all the students in this module were included in the research.

Students from foreign language (e.g. English and German Language and Literature), Slovenian, and Comparative Literature study programs prevailed with 76.7% of the whole sample. Females were also predominant in the sample (86%), which accurately reflects the actual participants in the study programs. Students respondents were 21 to 32 years old (M = 23.3; SD = 1.75). The age category 22 to 25 years represents more than 80% of all students in the research; only 9 students were older than 25 years.

Measures

Characteristics of motivation

In order to establish the connection between motivation and perception of the learning environment, we employed motivational scales from the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991), which is based on a social-cognitive approach to motivation and learning characterized by stressing the interconnection of the cognitive and emotional components of learning.

In the first part of the questionnaire, 20 items was used from the MSLQ, specifically from the “Intrinsic goal-orientation” and “Extrinsic

goal-orientation", "Self-efficacy" and "Control beliefs" scales. The respondents replied to the five-point Likert scale questionnaire with the following answer possibilities:

1 – Definitely not true of me,

2 – Mostly not true of me,

3 – Sometimes true and sometimes not true of me,

4 – Mostly true of me,

5 – Definitely true of me. A five-point scale instead of the original seven-point scale was used to unify scales across the questionnaire.

Evaluation of the learning environment

In addition to the scales from Motivated Strategies for Learning Questionnaire, we also used the Evaluation of the Learning Environment Questionnaire. The questionnaire, developed especially for this survey, is based on Moos' (1974) conceptualization of the learning environment, similar to many other questionnaires that were developed mainly for the use in primary or secondary education. However, the latter instruments are inappropriate for assessing the learning environment in higher education.

In this part of the questionnaire, 42 items were formed, representing the main dimensions of the learning environment: teacher support, student interaction, authentic learning, autonomy, and personal relevance. The respondents assessed their perceptions of learning environment on the course level by using the five-point Likert scale, which represented the frequency of

individual “events” in lectures. The following answers were possible: 1 – Never, 2 – Seldom, 3 – Sometimes, 4 – Often, 5 – Always. The number of components was first evaluated with the principal component analysis, and the results of this analysis showed six appropriate dimensions.

Characteristics of the learning environment which predict students’ motivation and course satisfaction

The theory and empirical findings show that perceptions of learning environment positively influence motivation and course satisfaction. Since correlation only tests for interdependence of the variables, we were also interested in describing the predictive value of learning environment. Correlation analysis (presented in Table 3) showed many moderate to high connections between motivation and evaluation of learning environment. Since learning environment variables were mostly correlated to intrinsic goal-orientation, we were interested to determine which of these variables is the most important in predicting intrinsic motivation.

The regression model is highly statistically significant and explains no less than 43% of the prediction of the dimensions of the learning environment of setting of intrinsic goals during learning ($F = 21.34$; $p < 0.001$). As can be seen in Table 4, two characteristics of the learning environment statistically significant affect the Intrinsic goal-orientation: perception of learning as authentic, connected to practical problems ($\beta = 0.43$) and perceived autonomy during their study ($\beta = 0.20$). These results show that the more that students see their learning as relevant and valuable for their practical experiences, the more intrinsically motivated they feel. Intrinsic orientation was also emphasized with the possibilities of taking

control over learning. This means that the more a teacher (according to the opinion of students) encourages and allows the autonomous decisions of students and provides them with opportunities to make co-decisions, the more the students perceive the studied topics as useful and the greater the probability they will be intrinsically motivated during their study.

Learning environment's effect on motivation

The results have shown that students who set themselves intrinsic goals have a greater sense of control of their learning and a feeling of self-efficacy. Furthermore, our study revealed that students who perceive their learning environment as a place that fosters autonomy and self-direction and find their education to be useful and relevant are more intrinsically motivated.

The importance of collaborative learning and teacher support is also underscored. The results of the regression analysis reflect the findings from the correlation analysis and give even more significance to the real-life problems of the studied topics, and support in developing autonomy.

The importance of the perceived authenticity of learning have also been proven in the correlation analysis. In this study, the interconnectedness of theoretical knowledge and practical application seems to be among the most important determinants of students' motivation for studying in higher education.

These findings are also supported by the research that has been done on goal-orientations. Ames and Archer (1988) found that goals set on the classroom level also affect the goals set by individual students. Students who believed that their learning environment

was performance-oriented and encouraging with regards to good grades and competition set themselves extrinsic goals also with learning.

Signal detection theory: Assumptions and applications

The Utility of Signal Detection Theory

Signal detection theory (SDT) is a technique that can be used to evaluate sensitivity in decision-making. Initially developed by radar researchers in the early 1950s (Peterson et al., 1954), the value of SDT was quickly recognized by cognitive scientists and adapted for application in human decision-making (Tanner and Swets, 1954; Green and Swets, 1966). The general premise of SDT is that decisions are made against a background of uncertainty, and the goal of the decision-maker is to tease out the decision signal from background noise. SDT can be applied to any binary decision-making situation where the response of the decision maker can be compared to the actual presence or absence of the target. The advantage of SDT as a measure of decision-making is that it provides a unitless measure of sensitivity, regardless of subject bias, that can be compared to other sensitivities over widely different situations.

Introduction and Scope

Signal detection theory (SDT) sprouted from World War II research on radar into a probability-based theory in the early 1950s. It specifies the optimal observation and decision processes for detecting electronic signals against a background of random interference or noise. The engineering theory, culminating in the

work of Wesley W. Peterson and Theodore G. Birdsall (Peterson et al. 1954), had foundations in mathematical developments for theories of statistical inference, beginning with those advanced by Jerzy Neyman and E. S. Pearson (1933).

SDT was taken into psychophysics, then a century-old branch of psychology, when the human observer's detection of weak signals, or discrimination between similar signals, was seen by psychologists as a problem of inference. In psychology,

SDT is a model for a theory of how organisms make fine discriminations and it specifies model-based methods of data collection and analysis. Notably, through its analytical technique called the receiver operating characteristic (ROC), it separates sensory and decision factors and provides independent measures of them. SDT's approach is now used in many areas in which discrimination is studied in psychology, including cognitive as well as sensory processes.

SDT has been applied within a broad range of topics, including memory research (e.g., Banks, 1970), accuracy in radiology diagnostics (e.g., Obuchowski, 2003), and sustained attention in individuals with ADHD (e.g., Huang-Pollock et al., 2012). Further testament to the utility of SDT comes from the fact that SDT is often discussed in introductory courses and textbooks (e.g., Wade et al., 2013; Lilienfeld et al., 2015). However even with the ubiquity of SDT as an evaluative tool, the mechanics of SDT are not typically discussed in undergraduate textbooks, suggesting that many students are not taught how to practically apply SDT in their university careers. One reason for this is that the procedure itself may appear deceptively complex. Most SDT sources discuss the

theory with a rigor that is beyond the mathematical knowledge of most undergraduate students (Fisher, 2014). However, the application of basic SDT principles requires only rudimentary statistical knowledge and can easily be taught at an undergraduate level.

Another reason that SDT may not typically be covered in the undergraduate curriculum is a lack of compelling examples to demonstrate the utility of SDT. Oftentimes, examples are related to sensory performance and the practical application of SDT techniques to more high-level decision-making situations is not immediately apparent to students. For example, Goldstein (2014) and Wolfe et al. (2015), two common introductory textbooks for Sensation and Perception, discuss the theory of SDT in relation to hearing sensitivity in the context of noise.

However, there are more inherently interesting examples that can be used in the classroom to demonstrate the versatility of SDT to learners. Given the importance of active learning through concrete examples when learning inherently abstract statistical principles such as SDT (e.g., Watts, 1991; Garfield and Ben-Zvi, 2007) the onus is on educators to develop compelling examples to capture the interest of undergraduate students. Here,

I argue that pseudoscientific “principles” can be used to demonstrate the power of SDT, given that many pseudoscientific results can be explained as the detection of patterns in meaningless noise.

The Mechanics of Signal Detection Theory: A Brief Overview

The basic premise behind SDT is that both signal and noise are represented probabilistically within the decision-maker, and the extent to which those representations overlap can be estimated based on the decision-maker's responses and whether or not the signal is present The decision-maker bases their decision relative to their criterion (β), where a signal will be reported present when the internal signal is stronger than β and absent when the internal signal is weaker than β. A hit represents the probability that the subject reports the signal present when it is and a false alarm represents the probability that the subject reports the signal present when it is absent.

Alternatively, a miss represents the probability that the subject reports the signal absent when it is present and a correct rejection represents the probability that the subject reports the signal absent when it is absent. All response probabilities are reflected as a part of the area underneath a normal curve. If the probability of each response type is therefore known, both the signal and the noise distributions can be estimated based on simple statistical principles.

Signal detection theory (SDT) is a framework for interpreting data from experiments in which accuracy is measured. In such experiments, two or more stimulus classes (signal and noise in a detection experiment, old and new items in a memory task) are sampled repeatedly, and an observer must select a response corresponding to the class actually presented. According to SDT, performance in such tasks is limited by observer sensitivity, which depends on the degree of overlap between the distributions of a decision variable produced by the stimulus classes.

Within this sensitivity constraint, observers can select from among a range of decision rules in order to satisfy performance goals. Experiments in which appropriate decision rules are manipulated allow the construction of receiver operating characteristics (ROCs); these functions allow response bias and sensitivity to be distinguished, and can be used to evaluate assumptions about the presumed distributions.

Because it specifies the manner in which accuracy in different discrimination methods depends on sensitivity, SDT allows performance to be predicted across paradigms.

Subliminal perception and related factors, information processing approach

The meaning of the term subliminal perception has changed over the years, and some prefer to use perception without awareness as an alternative that avoids the sometimes contentious issue of limen (threshold). Generally speaking, “Subliminal perception occurs whenever stimuli presented below the threshold or limen for awareness are found to influence thoughts, feelings, or actions” (Merikle, 2000).

Because an influence on thoughts, feelings, or actions is relatively easy to measure experimentally, the difficult part about the field is evaluating awareness of a stimulus below the subject's threshold. Central to the issue is knowing when a subject is consciously aware of a stimulus, and how this can be reliably ascertained in experiments.

Traditionally, the subjects themselves report awareness. While other areas of psychology may disapprove of introspection as a source of data, in the field of subliminal perception this self-report of "awareness" seems to be unavoidable. The inevitable use of the self-report has also lead to much debate over how these self-reports should be interpreted. The dissociation paradigm is the predominant experimental approach used in research on subliminal perception.

The term subliminal is derived from the terms sub (below) and limen (threshold), and it refers to perception so subtle it cannot reach conscious awareness. Most of the research on subliminal perception is done on visual subliminal perception. For instance, one can flash words or pictures so quickly on a computer screen (generally faster than 10-15 milliseconds) that perceivers have the feeling they do not see anything at all.

The first documented findings suggesting an effect that has come to be called "subliminal perception" (or perception without awareness) came from Pierce and Jastrow's (1884) work testing the human response to very similar, barely distinguishable stimuli. Pierce and Jastrow devised an experiment in which they each had to evaluate which of two pressures on skin was greater, along with a reported confidence level. The significant, and surprising, finding was that even when the subject indicated that they were guessing (zero confidence, implied 50% chance),

they were actually correct about which pressure was greater more than 60% of the time. The subjects were consistently more accurate than chance, but were not aware of any difference between the two stimuli.

These findings were later confirmed by other researchers, stirring interest about stimuli that were beneath the threshold of conscious awareness. Popular interest in this field was spurred by the claims of a marketing researcher, James Vicary (Merikle, 2000).

In 1957, Vicary claimed that patrons at a movie theatre were exposed to advertising messages Eat Popcorn and Drink Coca-Cola flashed for 3 millisecond durations and repeated throughout a movie. According to Vicary, patrons were not consciously aware of these hidden messages but responded favourably by significantly increasing their purchases of popcorn and drinks. There has not been any independent evidence to support the claims, and Vicary himself stated that the research was a fabrication (Merikle, 2000).

In other words, they are not consciously aware of the presented words or pictures. However, such visual stimuli are processed unconsciously, and they can have brief and subtle effects on our feeling and thinking. In addition, some research has been done on auditory subliminal perception. No reliable scientific evidence exists, however, for psychological effects of auditory subliminal perception.

The idea of an objective “threshold’ is misleading. No objective threshold exists for conscious perception. Whether a briefly presented stimulus reaches conscious awareness depends on many different factors, including individual differences. The threshold is merely subjective.

Effects of subliminal perception are generally small and not easy to establish in controlled laboratory research. However, a few findings are reasonably well established, the most prominent being subliminal mere exposure; Repeated subliminal exposure to a stimulus (for example a picture) leads perceivers to like this picture

a little more. Effects of mere exposure have even been obtained for stimuli that were perceived for only one millisecond. Perceivers can to some extent infer the valence (is something good or bad?) from subliminal stimuli. This is shown in research on the subliminal perception of short positive (e.g., sun) and negative (e.g., death) words.

Subliminal perception is controversial mainly because of the notion of subliminal persuasion: The strategy that may be used by marketers or politicians to deliberately influence customers or voters subliminally. In 1957, James Vicary claimed that he increased the sale of cola and popcorn in a New Jersey cinema by subliminally flashing “Drink Coke” and “Eat popcorn” during movies.

This however, turned out to be a myth. Perhaps because of the media attention subliminal perception and persuasion sometimes receives, most of the American population does believe subliminal persuasion to have far reaching consequences. However, although subliminal perception exists, research shows the effects to be minor and usually short-lived. There is no scientific reason to believe it can substantially change consumer behavior.

Debate over terms and methodology

The field of subliminal perception, or perception without awareness, has been marked by continual controversy. In recent years, experts within the field have been debating what qualifies as perception without awareness, and which forms of measurement are valid for experiments. Specifically, researchers question self reports from a subject in an experiment.

While Cheesman and Merikle (1984) have addressed the issue by classifying types of self reports, this controversy is far from resolved. Reingold and Toth (1996) describe one of the fundamental issues: . . . factors unrelated to awareness, such as demand characteristics and preconceived biases, may lead subjects to adopt a conservative response criterion and report null perceptual awareness even under conditions in which conscious perceptual information is available.

Response bias represents a threat not only to the validity of the subjective report measure of awareness, but also to its reliability. In particular, variability in response criteria makes it difficult to compare reports of null subjective confidence across-subjects, or within-subjects across conditions.

Just-Noticeable Differences (Pierce and Jastrow, 1884)

The first documented experiments by Pierce and Jastrow are not only interesting from a historical viewpoint, but also because the experiment alludes to subjective/objective thresholds discussed a century later (Kihlstrom et al., 1992). Pierce set out to research just-noticeable differences when the difference between stimuli was below a physiological threshold.

Two very similar pressures were exerted on the subject's hands, and the subject was forced to choose which of the two pressures was greater. Along with each choice, the subject rated their confidence on a scale of 0-3. Zero confidence denoted “absence of any preference for one answer over its opposite, so that it seemed nonsensical to answer at all” (Pierce and Jastrow, p. 77).

The results indicated a correlation between guesses and the actual proportion of pressures, even when the subjects were guessing (i.e. subliminal). Of the results at zero confidence, subjects guessed the greater pressure correctly in 62%, 70%, and 67% of trials (under different conditions). These results were consistently above 50%, the expected value for guessing.

Therefore, the subjects did perceive the stimuli even though they were not aware of them. A century later, Cheesman and Merikle (1984) defined a subjective versus objective criteria for the threshold which proves to have a major impact on the interpretation of this early experiment and all the others like it.

The subjective threshold would be the point at which subjects in the experiment could no longer report a difference in the stimuli (zero confidence).

However, the objective threshold would take into account the successes of the guesses and would rule out subliminal perception in this case (Kihlstrom et al., 1992, p. 20). Visual Masking and Word Recognition (Marcel, 1983) Marcel's famous experiments during the 1970s on visual masking and word recognition exemplify an entire class of experiments on the priming effects of words.

Subjects were shown a masked prime word (or not) and then a target consisting of a string of letters that was sometimes semantically associated to the target. This string of letters sometimes formed a real world, but other times was nonsense. Under one condition, subjects were asked whether the prime word was present. In the other condition, subjects were asked whether the target string was a word.

Subliminal Mere Exposure (Kunst-Wilson and Zajonc, 1980) The "mere exposure" effect refers to the finding that merely being exposed to a stimulus such as an object enhances the subject's attitude toward the stimulus (Zajonc, 1968). This phenomenon is one of affect rather than cognition, and emotional liking or preference after repeated exposure is exhibited both in humans and in animals.

Kunst-Wilson and Zajonc (1980) performed experiments to determine whether the mere exposure effect occurs when the stimulus is presented subliminally, under degraded conditions where subjects indicate no recollection of the stimulus. Their findings are quite surprising, and have since been replicated in many similar experiments. In Kunst-Wilson and Zajonc's (1980) experiment, subjects were exposed to irregular octagons that could easily be discriminated under normal circumstances.

In the exposure phase, the subjects first saw half of the octagons under "degraded" conditions (1 millisecond duration and poor illumination) which were determined to yield only chance level recognition. In other words, the subjects were later unable to recognize the stimuli they had seen during the exposure phase and so the stimuli were presented subliminally.

In the second phase, subjects had to make comparisons between two octagons under normal viewing conditions. One octagons had been subliminally presented to the subject during the exposure phase, and the other octagon was novel. Subjects were asked to both indicate which octagon they had seen before (recognition), and which octagon they liked better.

Exclusion Paradigm (Debner and Jacoby, 1994)

Recently, Debner and Jacoby (1994) have offered an "exclusion paradigm" which may be able to avoid the disputed aspects of the dissociation paradigm. The word completion experiment illustrates how the exclusion paradigm puts conscious and unconscious processes in conflict with each other. Subjects were first briefly flashed priming words for durations that ranged from subliminal to clearly perceptible. Subjects were then given word stems of partially completed words, and asked to complete the words.

However, subjects were instructed to not use the priming word in order to complete the partial word. If subjects were aware of the priming word, then they should avoid using it in the word completion task. However,

if the subjects were not aware of the priming word but had nevertheless perceived it (subliminal perception), then the priming word might influence their word completion task.

Debner and Jacoby (1994) found that indeed, priming words presented for very brief durations – the subliminal stimuli – were much more likely to be used in completing words than the priming words shown for longer durations. This provides an interesting new experimental format in contrast to the usual dissociation, since the exclusion paradigm shows distinct results for consciously versus unconsciously perceived stimuli.

Conclusion

While there is much evidence supporting the existence of some kind of perception without awareness, controversy has underscored research in the field. Experts disagree on what should be called subliminal perception, and how such effects can be measured

experimentally. Certainly, research has overwhelmingly demonstrated that people can perceive stimuli and act on them without reporting being consciously aware of the stimuli. However, whether or not this qualifies as true subliminal perception is a matter that is hotly debated.

The dissociation paradigm, as well as the thresholds for conscious awareness, have been thoroughly criticized.

However, newer findings – those of Kunst-Wilson and Zajonc (1980), and more recently Debner and Jacoby (1994) – tread in new directions that avoid the classical pitfalls of subliminal experiments. While the controversy will no doubt continue, the overwhelming body of evidence from a diverse set of independent experiments is hard to ignore. It seems that subliminal perception, in some form, does exist and can be reliably measured.

Information Processing

Basic Assumptions

The information processing approach is based on a number of assumptions, including:

(1) information made available by the environment is processed by a series of processing systems (e.g. attention, perception, short-term memory);

(2) these processing systems transform or alter the information in systematic ways;

(3) the aim of research is to specify the processes and structures that underlie cognitive performance;

(4) information processing in humans resembles that in computers.

The development of the computer in the 1950s and 1960s had an important influence on psychology and was, in part, responsible for the cognitive approach becoming the dominant approach in modern psychology (taking over from Behaviorism).

The computer gave cognitive psychologists a metaphor, or analogy, to which they could compare human mental processing. The use of the computer as a tool for thinking how the human mind handles information is known as the computer analogy.

Essentially, a computer codes (i.e., changes) information, stores information, uses information, and produces an output (retrieves info). The idea of information processing was adopted by cognitive psychologists as a model of how human thought works.

For example, the eye receives visual information and codes information into electric neural activity which is fed back to the brain where it is “stored” and “coded”. This information is can be used by other parts of the brain relating to mental activities such as memory, perception and attention. The output (i.e. behavior) might be, for example, to read what you can see on a printed page.

Hence the information processing approach characterizes thinking as the environment providing input of data, which is then transformed by our senses. The information can be stored, retrieved and transformed using “mental programs”, with the results being behavioral responses.

Cognitive psychology has influenced and integrated with many other approaches and areas of study to produce, for example, social learning theory, cognitive neuropsychology and artificial intelligence (AI).

Information Processing and Selective Attention

When we are selectively attending to one activity, we tend to ignore other stimulation, although our attention can be distracted by something else, like the telephone ringing or someone using our name.

Psychologists are interested in what makes us attend to one thing rather than another (selective attention); why we sometimes switch our attention to something that was previously unattended (e.g. Cocktail Party Syndrome), and how many things we can attend to at the same time (attentional capacity).

One way of conceptualizing attention is to think of humans as information processors who can only process a limited amount of information at a time without becoming overloaded.

Broadbent and others in the 1950s adopted a model of the brain as a limited capacity information processing system, through which external input is transmitted.

Information processing models consist of a series of stages, or boxes, which represent stages of processing. Arrows indicate the flow of information from one stage to the next.

- **Input** processes are concerned with the analysis of the stimuli.
- **Storage** processes cover everything that happens to stimuli internally in the brain and can include coding and manipulation of the stimuli.
- **Output** processes are responsible for preparing an appropriate response to a stimulus.

Critical Evaluation

A number of models of attention within the Information Processing framework have been proposed including:

Broadbent'sFilter Model (1958), Treisman's Attenuation Model (1964) and Deutsch and Deutsch's Late Selection Model (1963).

However, there are a number of evaluative points to bear in mind when studying these models, and the information processing approach in general. These include:

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1. The information processing models assume serial processing of stimulus inputs.

- **Serial processing** effectively means one process has to be completed before the next starts.
- **Parallel processing** assumes some or all processes involved in a cognitive task(s) occur at the same time.

There is evidence from dual-task experiments that parallel processing is possible. It is difficult to determine whether a particular

task is processed in a serial or parallel fashion as it probably depends (a) on the processes required to solve a task, and (b) the amount of practice on a task.

Parallel processing is probably more frequent when someone is highly skilled; for example a skilled typist thinks several letters ahead, a novice focuses on just 1 letter at a time.

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2. The analogy between human cognition and computer functioning adopted by the information processing approach is limited.

Computers can be regarded as information processing systems insofar as they:

(i) combine information presented with stored information to provide solutions to a variety of problems, and

(ii) most computers have a central processor of limited capacity and it is usually assumed that capacity limitations affect the human attentional system.

Culture and perception

How much alike, then, are two persons' sensations? Individuals raised in diverse cultures can actually sense the world differently. For example, Marshall Segall and his associates (Segall, Campbell, & Herskovits, 1966) found that people who live in forests or in rural areas can sense crooked and slanted lines more accurately than can people who live in urban areas.

This demonstrates that the rural and urban groups sense the same event differently as a result of their diverse cultural learnings. The term field dependence refers to the degree to which perception of an object is influenced by the background or environment in which it appears.

Some people are less likely than others to separate an object from its surrounding environment. When adults in Japan and the United States are shown an animated underwater scene in which one large fish swims among small fish and other marine life, the Japanese describe the scene and comment more about the relationships among the objects in the scene.

The Americans were more likely to begin with a description of the big fish and make only half as many comments about the relationships among the objects. Not surprisingly, when showed a second scene with the same big fish, the Americans were more likely to recognize the big fish as the same one as in the first scene (Nisbett, 2003).

More recently, Kitayama, Duffy, Kawamura, and Larsen (2003) showed Japanese and European Americans a picture of a square with a line inside it (see Figure 3.1). They were then given an empty square of a different size and asked to either draw a line the same length as the one they had seen or a line of the same relative length to the one they had seen.

The European Americans were significantly more accurate in drawing the line of the same length while the Japanese were significantly more accurate in drawing the line of relative length. Differences in the environment and culture affected sensation.

The researchers then compared Americans who had been living in Japan and Japanese who had been living in the United States. The time for both was a few years. Given the same picture and task, the Americans who had been living in Japan were close to the Japanese in the original study while the Japanese who had been living in the United States were virtually the same as the native-born Americans.

While other explanations are possible, one strong suggestion is that even living for an extended time in new culture can modify sensation and cognitive processes.

PERCEIVING

Culture also has a great effect on the perception process (Tajfel, 1969; Triandis, 1964). Human perception is usually thought of as a three-step process of selection, organization, and interpretation. Each of these steps is affected by culture.

Selection

The first step in the perception process is selection. Within your physiological limitations, you are exposed to more stimuli than you could possibly manage. To use sight as an example, you may feel that you are aware of all stimuli on your retinas, but most of the data from the retinas are handled on a subconscious level by a variety of specialized systems. Parts of our brains produce output from the retinas that we cannot “see.” No amount of introspection can make us aware of those processes. In an interesting study by Simons and Chabris (1999), participants viewed videotape of a basketball game. They were told to count the number of passes one team made. In the video, a woman dressed as a gorilla walks into the game, turns

to face the camera, and beats her fists on her chest. Fifty percent of all people who watch the video don't see the gorilla. Mack and Rock (1998) argue that we don't consciously see any object unless we are paying direct, focused attention on that object.

Perceptual Styles

Perceptual Style is the way you take in information through your five senses and make that information meaningful to you.

Your Perceptual Style acts as a filter between sensation and understanding. It is at the core of who you are, and it impacts your values, your beliefs, your feelings, and your psychology.

Each of us has one of six unique Perceptual Styles that is innate. Our individual Perceptual Style is literally hard wired and has grown with us as we've aged and developed. The decisions you make, the actions you take, and the directions you choose, are all influenced by your Perceptual Style. This is because our Perceptual Style defines our reality.

We often assume perceive and respond to the same objective reality and that there is one absolute "right." Research implies that not only is that untrue, but perception is actually a filter applied to objective reality, resulting in natural differences between people.

It is because of our varying Perceptual Styles that we all experience a different reality.

Here is a brief look at the six Perceptual Styles (presented in alphabetical order):

• **Activity:** People with the Activity Perceptual Style jump into life with both feet. They fully engage with the confidence that the details will sort themselves out. Direction, ideas, and pursuits emerge as the result of constant action and involvement with others and their surroundings. They engage until some new possibility or interest emerges to capture their attention. They cultivate extensive networks of friends and associates.

• **Adjustments:** People with the Adjustments Perceptual Style see the world as an objective reality that can be known if they take the time to gather complete information about its intricacies and complexities. They pursue the acquisition and application of knowledge as the basis for their life experience. They enjoy sharing their knowledge with others and gathering new information from research or conversation. They have a strong sense of diplomacy and project a calm certainty.

• **Flow:** People with the Flow Perceptual Style are instinctive advocates for the natural rhythms of life. They see the complex connectivity among seemingly unrelated people, environments, and situations. They intuitively integrate and harmonize their actions within a broadly defined community that provides them and others with a sense of belonging. They honor the continuity between past, present, and future.

• **Goals:** People with the Goals Perceptual Style stride through life focused on the accomplishment of specific results and well-defined objectives. They experience a sense of urgency and clarity of purpose. They believe achievement is primary and method or process secondary – the end justifies the means. They evaluate all activities based on possible contribution towards the achievement of the results they expect. They thrive on competition and believe that life is a constant competition with winners and losers.

• **Methods:** People with the Methods Perceptual Style approach life in a practical, matter-of-fact manner. They focus on how things need to be done. They believe that ordered processes, properly followed, will produce the desired results. They will discern the best process or technique to apply to any specific situation in order to produce reliable, repeatable outcomes. They impose order and they believe that everyone prefers to use well known and proven methods.

• **Vision:** People with the Vision Perceptual Style approach life as a singular experience, a journey toward the future. They face the realities of a situation with serious intent, an optimistic perspective that a solution will be found, and confidence that if one is not, there are always other alternatives to explore. They intuitively see new directions, and actions are taken or dropped opportunistically based on a sense of future possibilities and potential. They are highly persuasive and easily convince others to follow their vision.

All six Perceptual Styles provide distinctly different experiences of the world. These differences result in a profound psychological and perceptual diversity that is the most important diversity there is because it helps explain the differences between people.

The six Perceptual Styles together describe the total range of perceptual reality. However, individually each Perceptual Style has access to only 1/6 of the total. Everyone has one Perceptual Style that is innate and unchanging. All six Perceptual Styles are evenly distributed in the world, and research confirms there is no difference in regards to culture, race, gender, or age. All six have unique strengths and challenges.

The Perceptual Styles displayed in the circle graph below show the relationships between them.

Although all six are psychologically unique, each Perceptual Style shares some similarities with neighboring styles. Each is also attracted and repelled by its opposite style, and each finds the “one-off styles” somewhat puzzling.

Now let’s take an in-depth look at each Perceptual Style.

Activity

Activity people develop an intense fascination with things that captivate their imagination, and they seek to share the excitement of their experience within their personal network. They are uninterested in things they find tedious or no longer hold their curiosity. They move rapidly from one experience to the next.

Activity people draw on knowledge and previous experience from seemingly unrelated sources to create original and distinctive approaches and results. They find more enjoyment in activities that include members of their personal network. Positive response from their personal network is what drives them, and to that end they pay attention to cultivating and sustaining that network.

Activity people bring energy and vitality to their activities and are often instrumental in getting things started. They believe that life should be fun as well as productive.

Activity people resist details and analysis. They get easily bored with repetitive and routine tasks. They are always ready to jump into something new, and they lose interest in activities that do not deliver attention-grabbing results. They quickly abandon anything they find boring and will wander off in search of other groups or activities that need energizing

Activity people function best in settings that require interaction and allow them to get involved, share insight, tell stories, provide help, and communicate their perspective to others.

Adjustments

The actions of Adjustments people reflect their skills in collating, analyzing, and sharing what they know in useful ways. They create intricate systems for the storage and retrieval of their knowledge.

The greatest satisfaction for Adjustments people comes from being an information resource for others rather than only applying the information themselves. As such, they are good at explaining and describing complex, detailed, or technical information. Their thoroughness, patience with repetitive tasks, and desire for perfection allow them to spot where information is missing or fuzzy. They edit the written work of others effectively. They actively polish and hone their knowledge, their systems, and their processes to increase elegance and accuracy. They are at their best when given the time to do things carefully and systematically.

Time pressure, competition, and a drive for the bottom-line all violate their view of the world. They believe these conditions lead to a false sense of urgency and impulsive actions that are based on incomplete understanding. They are intrigued by the exploration of ideas when the exploration is characterized by careful and comprehensive analysis that leads to slow evolutionary change.

Because Adjustments people see an effective environment as a complex system that usually requires only incremental alterations and additions rather than wholesale rework, they modify and correct existing processes judiciously.

Flow

They create and sustain powerful but subtle relationships that form the glue of a community (family, friends, workgroup, social group, etc). They move smoothly and easily between daily events as their awareness emerges and recedes. They attend, in proper proportion, to events and people that require their attention, trusting that what needs to be done will be done.

Flow people facilitate the development of an environment that is comfortable, one that fosters and encourages people. When their environment shifts away from people centered community, they quietly influence its realignment, putting their personal needs aside if necessary to bring it back into harmony.

Flow people welcome new events that support their traditions and values. They use relational communities to gather and transmit informal information, after they have decided what to pass on and what to withhold. Their information sharing is so subtle that others

experience the contribution Flow people make to create connection within the community but are often unaware of its source

Flow people provide aid and assistance to the members of a community by serving as a listening post, encouraging development and growth, and empathizing with those who are struggling

They are excellent administrators who interpret policy and procedure for their community. It is important to them that the value of the community is accurately perceived by outsiders. They are keepers of community history and tradition and provide continuity between the past, present, and future. They use the history of the community to keep it grounded

The activities of Flow people are ultimately focused on support and maintenance of their community.

Goals

Goals people distrust complexity, subtlety, and solutions that evolve slowly over time. They believe that if a problem needs a solution, there is no time like the present to solve it.

Goals people approach the world with intense energy and have a high level of endurance that allows them to push themselves well after others have given up. They take action with personal intensity and urgency, and they are always anxious to get on to the next task even before the current one is complete. What needs to be done next is obvious to them, so they do not understand why others around them do not see and act on it.

Goals people are very outcome oriented and as such prefer to focus on the accomplishment of goals on which they can see immediate progress. They have no loyalty to current processes or methods and will abandon them quickly if progress towards a solution is slowing down and stagnating. They make high achievement demands on others but never more than they demand from themselves.

Goals people approach life as a competition, and if they find no other worthy competitor they will compete with themselves to see how far they can push themselves in terms of speed, quantity, and endurance.

Goals people are decisive in crises and adept at bringing structure out of chaotic situations. Their single-minded focus allows them to see the fundamental issues in problem situations, to determine the most important task, and to prioritize the steps necessary to accomplish their goal.

Methods

Methods people follow an ordered set of steps that when performed in a repeatable, logical sequence, inevitably end with the achievement of their objectives. They believe there is a correct method by which each problem, undertaking, or objective can be best handled. Discovering and applying this method is what drives them.

Once the desired result has been determined Methods people do not question it. Instead, they seek to find the steps that will produce the desired outcome with the most efficient use of time, money, and energy. They believe that failure of a solution to work is due to

human error in the application of a correctly designed course of action

Methods people analyze, manipulate, and apply facts. They use a rational application of facts to make decisions and solve problems, and they are confident that through this method they will arrive at the correct conclusion.

Methods people avoid becoming overly involved on a personal or emotional level and view both as distractions from the objectivity necessary to function effectively

Methods people are matter-of-fact and consistent in high-pressure environments. Their ability to see structure and impose order allows them to help others function in the face of chaos and uncertainty.

Vision

Vision people face the realities of a situation with serious intent, an optimistic perspective that a solution will be found, and confidence that if one is not, there are always other alternatives to explore.

Vision people intuitively see new directions that others do not and make the most of this advantage by moving decisively. This ability to intuit new, useful directions and to take swift advantage of opportunities as they arise, gives them a strategic edge over others.

Vision people are unafraid of taking risks and accept that the possibility of high rewards carries with it an equal possibility of failure. However, they view failure as only a temporary setback. They love to play with, explore, and develop new ideas, and they examine all aspects, possible outcomes, and consequences without preconception or judgment

Vision people change direction when progress towards achievement of their vision is slow or blocked, and as they move forward, they constantly tinker, experiment, and improvise with their actions in order to increase the likelihood of success. They are strongly committed to achieving their vision but are extremely flexible about the path taken to get there.

Vision people think non-linearly about problems, use their intuition, and try multiple possible solutions as they troubleshoot. When focused on an issue they work it to the exclusion of all else, often until they are exhausted.

Vision people are highly persuasive and easily convince others that the current topic is most important. They enlist others to join them with equal excitement and commitment.

Vision people see multiple successful scenarios, and they coordinate complex information and activities so that all efforts lead towards success.

Understanding Different Perceptual Styles For Life Success

The differences between people are often seen as the result of a lack of knowledge, bias, or stubbornness when in truth they are simply a matter of unchangeable biology. Instead of taking a stance that there is a right and wrong way to view things, its best to acknowledge that variations in opinion are due to biologically based perceptual differences.

People literally perceive the world differently, and this differing perception leads to different conclusions about what is important, how things should be done, and what is the “truth” of any situation.

Pattern Recognition

Pattern recognition is the process of recognizing patterns by using machine learning algorithm. Pattern recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or their representation. One of the important aspects of the pattern recognition is its application potential.

Examples: Speech recognition, speaker identification, multimedia document recognition (MDR), automatic medical diagnosis. In a typical pattern recognition application, the raw data is processed and converted into a form that is amenable for a machine to use. Pattern recognition involves classification and cluster of patterns.

- In classification, an appropriate class label is assigned to a pattern based on an abstraction that is generated using a set of training patterns or domain knowledge. Classification is used in supervised learning.
- Clustering generated a partition of the data which helps decision making, the specific decision making activity of interest to us. Clustering is used in an unsupervised learning.

Features may be represented as continuous, discrete or discrete binary variables. A feature is a function of one or more measurements, computed so that it quantifies some significant characteristics of the object.

Example: consider our face then eyes, ears, nose etc are features of the face.

A set of features that are taken together, forms the **features vector**.
Example: In the above example of face, if all the features (eyes, ears, nose etc) taken together then the sequence is feature vector([eyes, ears, nose]). Feature vector is the sequence of a features represented as a d-dimensional column vector. In case of speech, MFCC (Melfrequency Cepstral Coefficent) is the spectral features of the speech. Sequence of first 13 features forms a feature vector.

Pattern is everything around in this digital world. A pattern can either be seen physically or it can be observed mathematically by applying algorithms.

Example: The colours on the clothes, speech pattern etc. In computer science, a pattern is represented using vector features values.

Pattern recognition possesses the following features:

- Pattern recognition system should recognise familiar pattern quickly and accurate

- Recognize and classify unfamiliar objects
- Accurately recognize shapes and objects from different angles
- Identify patterns and objects even when partly hidden
- Recognise patterns quickly with ease, and with automaticity.

Training and Learning in Pattern Recognition

Learning

is a phenomena through which a system gets trained and becomes adaptable to give result in an accurate manner. Learning is the most important phase as how well the system performs on the data provided to the system depends on which algorithms used on the data. Entire dataset is divided into two categories, one which is used in training the model i.e. Training set and the other that is used in testing the model after training, i.e. Testing set.

Training

Training set is used to build a model. It consists of the set of images which are used to train the system. Training rules and algorithms used give relevant information on how to associate input data with output decision. The system is trained by applying these algorithms on the dataset, all the relevant information is extracted from the data and results are obtained. Generally, 80% of the data of the dataset is taken for training data.

Testing

Testing data is used to test the system. It is the set of data which is used to verify whether the system is producing the correct output after being trained or not. Generally, 20% of the data of the dataset is used for testing. Testing data is used to measure the accuracy of

the system. Example: a system which identifies which category a particular flower belongs to, is able to identify seven category of flowers correctly out of ten and rest others wrong, then the accuracy is 70 %

Real-time Examples and Explanations:

A pattern is a physical object or an abstract notion. While talking about the classes of animals, a description of an animal would be a pattern. While talking about various types of balls, then a description of a ball is a pattern. In the case balls considered as pattern, the classes could be football, cricket ball, table tennis ball etc. Given a new pattern, the class of the pattern is to be determined. The choice of attributes and representation of patterns is a very important step in pattern classification. A good representation is one which makes use of discriminating attributes and also reduces the computational burden in pattern classification.

An obvious representation of a pattern will be a **vector**. Each element of the vector can represent one attribute of the pattern. The first element of the vector will contain the value of the first attribute for the pattern being considered.

Example: While representing spherical objects, (25, 1) may be represented as an spherical object with 25 units of weight and 1 unit diameter. The class label can form a part of the vector. If spherical objects belong to class 1, the vector would be (25, 1, 1), where the first element represents the weight of the object, the second element, the diameter of the object and the third element represents the class of the object.

Advantages:

- Pattern recognition solves classification problems

- Pattern recognition solves the problem of fake bio metric detection.
- It is useful for cloth pattern recognition for visually impaired blind people.
- It helps in speaker diarization.
- We can recognise particular object from different angle.

Disadvantages:

- Syntactic Pattern recognition approach is complex to implement and it is very slow process.
- Sometime to get better accuracy, larger dataset is required.
- It cannot explain why a particular object is recognized. Example: my face vs my friend's face.

Applications:

- **Image processing, segmentation and analysis**
  Pattern recognition is used to give human recognition intelligence to machine which is required in image processing.
- **Computer vision**
  Pattern recognition is used to extract meaningful features from given image/video samples and is used in computer vision for various applications like biological and biomedical imaging.
- **Seismic analysis**
  Pattern recognition approach is used for the discovery, imaging and interpretation of temporal patterns in seismic

array recordings. Statistical pattern recognition is implemented and used in different types of seismic analysis models.

- **Radar signal classification/analysis**
  Pattern recognition and Signal processing methods are used in various applications of radar signal classifications like AP mine detection and identification.

- **Speech recognition**
  The greatest success in speech recognition has been obtained using pattern recognition paradigms. It is used in various algorithms of speech recognition which tries to avoid the problems of using a phoneme level of description and treats larger units such as words as pattern

- **Finger print identification**
  The fingerprint recognition technique is a dominant technology in the biometric market. A number of recognition methods have been used to perform fingerprint matching out of which pattern recognition approaches is widely used.

Ecological Theory of Perception

During World War II, difficulties had been encountered in the flying of aircraft, particularly landing, and in the training of pilots (Gibson, 1979/1986). Tests had been given for depth perception using the static, frozen-in-time, stimulus presentations in two dimensions that are intended to assess perception of monocular and binocular depth cues. Tests might be for linear perspective or apparent size, or other monocular or binocular cues of depth. None of these tests, as it turned out, were able to predict how well a student pilot would perform. The traditional theory of depth perception was not working;

it failed to apply where it should have. Gibson puzzled over this and came to realize that the traditional theory of depth perception was wrong.

Helmholtz (1866, in F. H. Allport, 1955) had struggled with the fact that visual perception of three dimensions was based upon a two-dimensional structure—the retina (the retina was flat and visual sensations without depth; Gibson, 1966). It was not possible, given that barrier, to perceive the three dimensions immediately. Helmholtz proposed that cues, which were signs of distance, provided the basis for making unconscious inferences regarding size and distance (Hilgard, 1987).

Based upon his research Gibson (1979/1986) began to suspect that the traditional list of depth cues was simply not sufficient. Pondering the situation, he theorized that light provided information and that the changes taking place

in the surrounding field of light (an array of reflections from objects) provided a form of information that the static displays did not. In the "optic array," an "optic flow pattern" was provided, by the changes in the structure of surrounding light, with information about one's position relative to environmental objects, and changes in that relation as one moves through time and space.

It was clear to Gibson that each approach—the classical approach and his—had a very different conception regarding the stimulus of perception.

Gibson was of the view that visual perception is due to the fact that ambient (surrounding) light conveys visual information that is accessible directly rather than being based upon visual cues (or

clues) from the retina which have to be interpreted. Regarding his work prior to this realization, Gibson wrote: I failed to distinguish between stimulation proper and stimulus information, between what happens at passive receptors and what is available to active perceptual systems.

Traditional psychophysics is a laboratory discipline in which physical stimuli are applied to an observer. He is prodded with controlled and systematically varied bits of energy so as to discover how his experience varies correspondingly.

Gibson was working from the assumption that humans actively extract information from the environment that they use to guide their deliberations regarding how to act next. More than that, Gibson was putting forward an “ecological theory” that proposed that there was no absolute division between subject and object, perceiver and perceived (analogous to the assumed division into the stimulus–response sequences of discrete events).

There was a symbiosis between the perceptual apparatus and the environment that it evolved to perceive; perceiver and thing perceived were a system in which there was a constant, ongoing provision of feedback that served as information for the purposeful regulation of continuing activities.

Based upon his recent revelations, regarding the apparent, direct access to the real environment for perception, Gibson, between 1957 and 1961, worked toward developing a new theory of perception that would be consistent with direct realism – an ecological theory of perception (Lombardo, 1987). Up to that point, the person was seen as an individual who was isolated from the environment and that resulted in a metaphysical dichotomy (in the

sense that two divisible and completely separate entities confronted and opposed each other). There was the subject (the individual who perceived the world) and the object (that which was perceived).

The result of such conceptual dichotomization was the puzzle of how an individual could perceive the world and to what degree phenomenological experience reflects the true nature of that objective world. This was the difficulty that Gibson would struggle with.

Psychology has long paid homage to evolutionary theory without appreciating the full implication of that theory for psychology. Darwin, on the other hand, was completely aware of the possible contribution of his theory to psychology: In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history.

Mental powers evolved. They are not of a separate realm called mind nor are they apart from the world of nature; they are processes of nature, natural and material. Humans do not gaze upon the world from some distant, non-organic, supra-natural, plateau, separate from and independent of the remainder of living forms. We are of nature, bound to nature, its product. Mental processes are material processes (not of some separate substance called mind) that evolved because they were serviceable to continued existence in a material world.

Darwin's theory was that nature provides obstacles to survival, e.g., drought, famine, pestilence, changing climate, and so on, and that those individuals that were suited to these changed conditions

would thrive and survive. This meant that variability of characteristics, within a species, would enhance chances for the survival of the species (not particular individuals). Those individuals, from the species as a whole, that could adapt to changing conditions would be the ones that would carry the species forward (in terms of evolutionary development).

The adapting individuals were selected by nature (a purely random, nonconscious, unintentional process) to continue to exist and have offspring. The adaptive characteristics were passed on to offspring through reproduction. By these means adaptive characteristics would be passed throughout the surviving members of the species and, through a very gradual process, could result in alterations of the species characteristics (morphologically or behaviorally). Darwin surmised that mental processes, upon appearing, were serviceable to continued existence and would therefore be favored by random selection processes.

Gibson's Ecological Theory In his ecological theory,

Gibson (1966, 1979/1986) emphasizes the inseparable relation between perceptual systems and the physical world in which they evolved. The words animal and environment, from this perspective, imply each other; they cannot be disconnected. Reciprocity exists between animal and environment and, while they are distinguishable, they are mutually supportive (Lombardo, 1987). The ecological approach takes as its unit of study the animal in its environment, considered as an interactive system.

The relations within this system are reciprocal, with the reciprocity including a species evolving in an environment to which it becomes adapted, and an individual acting in its own niche, developing and

learning. (Gibson and Pick, 2000, p. 14) In this reciprocal interaction the environment makes available resources, opportunities and information for action.

Actions themselves result in feedback (more information) that can lead to alterations in action. When chasing down prey, for instance, if it begins to pull away from one, speed can either be increased to compensate and overtake, or the chase broken off if that is not possible. In progressing toward some end, whatever that may be, one can continuously monitor one's progress and make adjustments as required.

Perception can be conceived of as an evolved adaptation to lawful relations between the environment and the energy arrays, e.g., optic, acoustic, chemical, that surround individuals and act upon their sensory receptors. It is through the ecological reciprocity that Gibson transcends the barrier of the senses and discovers the basis for direct realism. This was not a position, however, that Gibson arrived at easily or without a great deal of thought and experimentation. In order to get to that point Gibson, who had originally been aligned with the constructionists, had to realize that problems existed for that perspective.

Gibson's discontent was not simply with the stimulus materials and experimental methods of the constructionists. With Helmholtz the place of commencement for the study of vision was at the retina, with sense impressions and receptor reactions. Up to 1950 this had been Gibson's focus, i.e., the retinal image as the stimulus for the eye (Gibson, 1966). With a change in perspective, he proposed that Newton had misled us when he suggested that light rays painted a picture of the visible object on the back of the eye. The retinal

image, contrary to this, is not a picture. That is misleading since it suggests something looked at. The retinal image is a scintillation—a flash or a trace—because the retina jerks about (saccadic movement) and it has a gap called the blind spot where the optic nerve leaves the eye. It was a further misconception,

argued Gibson, to think that a retinal sensory pattern can be impressed on the brain neural tissue since the neural pattern never existed in the retinal mosaic. A further reason for discounting the retina as the basis for visual perception was what was found through cross-species comparisons.

The visual organs of octopi, rabbits, bees, spiders, flies, and humans differ widely but all suggest visual perception of those conditions in the environment that are essential to surviving.

What is Learning Process: Fundamental theories: Thorndike, Guthrie, Hull Classical Conditioning: Procedure, phenomena and related issues Instrumental learning: Phenomena, Paradigms and theoretical issues; Reinforcement: Basic variables and schedules; Behaviour modification and its applications Cognitive approaches in learning: Latent learning, observational learning. Verbal learning and Discrimination learning

Recent trends in learning: Neurophysiology of learning?

Learning Process: Fundamental theories: Thorndike, Guthrie, Hull Classical Conditioning: Procedure, phenomena and related issues Instrumental learning: Phenomena, Paradigms and theoretical issues; Reinforcement: Basic variables and schedules; Behaviour modification and its applications Cognitive approaches in learning: Latent learning, observational learning. Verbal learning and Discrimination learning Recent trends in learning: Neurophysiology of learning

Learning Process: Fundamental theories: Thorndike, Guthrie, Hull Classical

The underlying ability a teacher must have to orchestrate differentiated instruction day after day, hour after hour, by assessing his/her students and adjusting strategies and tactics moment by moment, requires sophisticated knowledge and skills.

To successfully use differentiated instruction, a teacher must first have a firm understanding of each of the cognitive components of the learning process, what they look like when they are working, and what the specific subcomponents of each look like when they are breaking down. Next, a teacher must develop a rich repertoire of strategies and tactics from which to pull the exact strategy or tactic

that will address a specific breakdown for a specific task, at the right moment. Using a great strategy at the wrong time, or mismatching a strategy with breakdown for which the strategy will yield no gains, will frustrate students and teachers alike when the strategy fails to produce the desired result.

There are six interactive components of the learning process: attention, memory, language, processing and organizing, graphomotor (writing) and higher order thinking. These processes interact not only with each other, but also with emotions, classroom climate, behavior, social skills, teachers and family.

In order to engage, motivate and teach all learners at optimal levels, teachers must understand the learning process in general, understand and respond to students' individual emotional and cognitive profiles and select instructional strategies and tactics that are effective for diverse learners.

Attention

Paying attention is the first step in learning anything. It is easy for most of us to pay attention to things that are interesting or exciting to us. It is difficult for most of us to pay attention to things that are not. When something is not interesting to us, it is easier to become distracted, to move to a more stimulating topic or activity, or to tune out.

The teacher's job is to construct lessons that connect to the learner. Relating what is to be taught to the students' lives can accomplish this. Relate Romeo and Juliet, for example, to the realities in our communities of prejudice, unfounded hatred and gang wars. Or relate today's discrimination to The Diary of Anne Frank, and hold

class discussions of discrimination that students have personally experienced or witnessed.

Physical movement can help to “wake up” a mind. When a student shows signs of inattentiveness and/or restlessness, teachers can provide the student with opportunities to move around. Many students with attention challenges actually need to move in order to remain alert. It is wise to find acceptable, non-destructive ways for these students to be active. Responsibilities such as erasing the board, taking a message to the office, and collecting papers can offer appropriate outlets for activity.

Memory

Memory is the complex process that uses three systems to help a person receive, use, store, and retrieve information. The three memory systems are (1) short-term memory (e.g., remembering a phone number you got from information just long enough to dial it), (2) working memory (e.g., keeping the necessary information “files” out on the mind’s “desktop” while performing a task such as writing a paragraph or working a long division problem), and (3) long-term memory (a mind’s ever expanding file cabinet for important information we want to retrieve over time).

Children in school have to remember much more information every day than most adults do. Adults generally have more specialized days – mechanics use and remember mechanical information, dentists use and remember information about dentistry, and so on. On the other hand, school expects that children become experts in several subjects – e.g., math, language, science, social studies, a foreign language, the arts.

It is important to remember that when a student understands something, it does not guarantee that he will remember it. For example, a person may understand a joke that he heard at a party on Saturday night, but he may have trouble remembering it when he tries to tell it to his friends on Monday.

In order to enhance the likelihood that all students will elaborate on new information, teachers should activate their prior knowledge and make new information meaningful to them. For example, a teacher may ask second graders how to divide a pan of brownies evenly among the 20 students in the class, and then connect their solution to the concept of equivalent fractions. Relating how algebraic equations need to be equal or balanced on both sides to the benefits of dividing candy or cookies evenly between friends also connects to prior knowledge.

Students who have difficulty with both short-term and working memory may need directions repeated to them. Giving directions both orally and in written form, and giving examples of what is expected will help all students. All students will benefit from self-testing. Students should be asked to identify the important information, formulate test questions and then answer them. This tactic is also effective in cooperative learning groups and has been shown by evidence-based research to increase reading comprehension (NICHD, 2000).

Language

Language is the primary means by which we give and receive information in school. The two language processing systems are expressive and receptive. We use expressive language when we speak and write, and we use receptive language when we read

and listen. Students with good language processing skills usually do well in school. Problems with language, on the other hand, can affect a student's ability to communicate effectively, understand and store verbal and written information, understand what others say, and maintain relationships with others.

Most students, especially those with weaknesses in written language, will benefit from using a staging procedure for both expository and creative writing. With this procedure, students first generate ideas. Next they may organize their ideas. Third, they may look at sentence structure. Then they examine their spelling. Finally, they attend to mechanical and grammatical rules. It is also helpful for students to list their most frequently occurring errors in a notebook and refer to this list when self-correcting.

All students will benefit from systematic, cumulative, and explicit teaching of reading and writing.

Students who have receptive language challenges such as a slower processing speed must use a lot of mental energy to listen, and, therefore, may tire easily. Consequently, short, highly structured lectures or group discussion times should be balanced with frequent breaks or quiet periods. Oral instructions may also need to be repeated and/or provided in written form.

Cooperative Strategic Reading (Klinger, Vaughan, Hughes, Schumm, and Elbaum as referenced in Marzola 2006) is another way to engage students in reading and at the same time increase oral language skills. This tactic is ideal for promoting intellectual discussion and improving reading comprehension of expository text in mixed-level classrooms across disciplines. Using this tactic, students are placed into cooperative learning groups of four to six

students of mixed abilities. The students work together to accomplish four main tasks: (1) preview (skim over the material, determine what they know and what they want to learn), (2) identify clicks and clunks (clicks = we get it; clunks = we don't understand this concept, idea or word), (3) get the gist (main idea) and (4) wrap up (summarize important ideas and generate questions (think of questions the teacher might ask on a test). Each student in the group is assigned a role such as the leader/involver/taskmaster, the clunk expert, the gist expert, and the timekeeper/pacer (positive interdependence). Each student should be prepared to report the on the group's conclusions (individual accountability).

Broadening the way we communicate information in the classroom can connect all students more to the topic at hand, and especially students with language challenges. Using visual communication such as pictures and videos to reinforce verbal communication is helpful to all students, and especially to students with receptive language challenges. Challenge students to invent ways to communicate with pictures and other visuals, drama, sculpture, dance and music, and watch memory of key concepts increase and classrooms come alive.

Organization

We process and organize information in two main ways: simultaneous (spatial) and successive (sequential). Simultaneous processing is the process we use to order or organize information in space. Having a good sense of direction and being able to "see" how puzzle pieces fit together are two examples of simultaneous processing. Successive processing is what we use to order or organize information in time and sequence. Concepts of time, dates, and order – yesterday, today, and tomorrow, months of

the year, mathematical procedures such as division and multiplication, word order in sentences, and sentence order in paragraphs are examples of sequential processing. Students who are good at successive organization usually have little or no trouble with time management and usually find it easy to organize an essay in a sequence that is logical.

Students who have trouble with understanding spatial or geographical problems may need successive verbal explanations given to them. They may benefit from writing written explanations and descriptions of the information contained in charts, graphs or diagrams. Teachers should model this process for all students.

Students who have trouble remembering sequences of information but who are strong in simultaneous processing should benefit from graphic organizers, and making diagrams or flow charts of sequential information such as events in history rather than the standard timeline. They may benefit from software programs such as Inspiration that organize concepts and information into visual maps.

Practicing cooperative learning allows each student's processing and organizing strengths to be utilized to the benefit of the group. For example, those who are strong in simultaneous organization may create the group's chart, visual, or map, and those strong in successive organization may be the task step organizers, the taskmasters, timekeepers and pace setters.

Graphomotor

The writing process requires neural, visual, and muscular coordination to produce written work. It is not an act of will but rather an act of coordination among those functions. Often the student

who seems unmotivated to complete written work is the student whose writing coordination is klutzy. We have long accepted that students may fall on a continuum from very athletic to clumsy when it comes to sports, but we have not known until recently that some students are writing "athletes" while others writing klutzes. Just as practice, practice, practice will not make a football all-star out of an absolute klutz, practice and acts of will not make a writing all-star out of someone whose neurological wiring does not allow her to be a high performing graphomotor athlete.

Students with handwriting difficulties may benefit from the opportunity to provide oral answers to exercises, quizzes, and tests. Having computers in place for all children helps level the playing field for the graphomotor klutz. Parents and teachers should be aware, however, that many children with graphomotor challenges may also have difficulty with the quick muscular coordination required by the keyboard.

Higher Order Thinking

Higher order thinking (HOT) is more than memorizing facts or relating information in exactly the same words as the teacher or book expresses it. Higher order thinking requires that we do something with the facts. We must understand and manipulate the information.

HOT includes concept formation; concept connection; problem solving; grasping the "big picture"; visualizing; creativity; questioning; inferring; creative, analytical and practical thinking; and metacognition. Metacognition is thinking about thinking, knowing about knowing, and knowing how you think, process information, and learn.

All students will benefit from advance organizers that relate the big picture and the main concepts to be covered. Also, all students should be explicitly taught how to build concept maps (graphic organizers that connect all components of a concept, and may also connect one concept to another concept).

Give choices for projects and exams that include analytical, practical and creative thinking options. For example, an analytical choice might be to compare and contrast the events of the Holocaust to events in Rwanda. A practical choice might be to show how we can apply the lessons learned from the Holocaust to how we treat one another in our schools. A creative choice might be to write a play about tolerance, create a dance that communicates the emotions of the Holocaust, or write a poem or paint a picture that tells a story about how you feel about the conditions in Darfur.

Providing ample opportunities in the classroom for self-evaluation and self-reflection helps students develop self-understanding. Self-Evaluation… Helping Students Get Better At It! By Carol Rolheiser is listed in the reference section following this article and is a helpful resource for teachers who want to incorporate more student self-evaluation in their classrooms.

A student with metacognition can answer the question, “How am I smart?” The first part of metacognition is thinking about thinking. If a person has metacognition, he understands the way he thinks, and he understands his strengths and challenges in specific skill areas, subjects and activities.

A person with metacognition also monitors and regulates how he learns. He can take a task and decide how best to accomplish it by using his strategies and skills effectively. He knows how he would

best learn a new math procedure and which strategies he would use to understand and remember a science concept. He understands the best way for him to organize an essay – whether he would be more successful by using an outline, a graphic organizer or a mind map. He has mental self-management.

Psychologist Robert Sternberg lists six components of mental self-management:

1. Know your strengths and weaknesses.
2. Capitalize on your strengths and compensate for your weaknesses.
3. Defy negative expectations.
4. Believe in yourself (self-efficacy).
5. Seek out role models.
6. Seek out an environment where you can make a difference.

Ultimately, this is where we hope students who attend our schools will be upon graduation. As adults, we should model our own metacognition, talk about metacognition, and give meaningful examples of metacognition often and well.

Teaching students about the six components of the learning process – attention, memory, language, processing and organizing, graphomotor (writing) and higher order thinking, then, demystifies learning and provides an opportunity to increase their metacognition. It also enhances their sense of self-worth. A student who understands that she may need to use a particular strategy to help her working memory function better or that taking frequent breaks will help her stay more focused on her homework assignments is much better off than thinking that she is stupid or lazy.

Emotions

Emotions control the on-off switch to learning. When we are relaxed and calm, our learning processes have a green light. When we are uptight, anxious, or afraid, our learning processes have a red light. In the classroom, tension slams the steel door of the mind shut. Creating a non-threatening classroom environment or climate where mistakes are welcomed as learning opportunities reduces tension, opens the mind and increases the opportunity for learning.

The more teachers know about how learning takes place – how information is processed, manipulated and created, the more we will know about what it looks like when it's working and what it looks like when it starts to break down. Then, rather than thinking a student isn't motivated, teachers will look to see if it is attention, memory, language, organizing, graphomotor or higher order thinking that needs an intervention.

Motivation

It is every teacher's job to motivate every student. Learning more about the brain and the development of the mind, studying new information on learning, making learning meaningful and learning about learning, watching the learning process, monitoring closely for breakdowns, and celebrating the successes of every student – these are our challenges as we create schools that honor diversity – the schools all children deserve.

Fundamental theories: Thorndike

Edward Thorndike (1898) is famous in psychology for his work on learning theory that lead to the development of operant conditioning within Behaviorism.

Whereas classical conditioning depends on developing associations between events, operant conditioning involves learning from the consequences of our behavior.

Skinner wasn't the first psychologist to study learning by consequences. Indeed, Skinner's theory of operant conditioning is built on the ideas of Edward Thorndike.

Thorndike studied learning in animals (usually cats). He devised a classic experiment in which he used a puzzle box (see fig. 1) to empirically test the laws of learning.

He placed a cat in the puzzle box, which was encourage to escape to reach a scrap of fish placed outside. Thorndike would put a cat into the box and time how long it took to escape. The cats experimented with different ways to escape the puzzle box and reach the fish.

Eventually they would stumble upon the lever which opened the cage. When it had escaped it was put in again, and once more the time it took to escape was noted. In successive trials the cats would learn that pressing the lever would have favorable consequences and they would adopt this behavior, becoming increasingly quick at pressing the lever.

Edward Thorndike put forward a "**Law of effect**" which stated that any behavior that is followed by pleasant consequences is likely to be repeated, and any behavior followed by unpleasant consequences is likely to be stopped.

Critical Evaluation

Thorndike (1905) introduced the concept of reinforcement and was the first to apply psychological principles to the area of learning.

His research led to many theories and laws of learning, such as operant conditioning. Skinner (1938), like Thorndike, put animals in boxes and observed them to see what they were able to learn.

The learning theories of Thorndike and Pavlov were later synthesized by Hull (1935). Thorndike's research drove comparative psychology for fifty years, and influenced countless psychologists over that period of time, and even still today.

The theory suggests that transfer of learning depends upon the presence of identical elements in the original and new learning situations; i.e., transfer is always specific, never general. In later versions of the theory, the concept of “belongingness” was introduced; connections are more readily established if the person perceives that stimuli or responses go together (c.f. Gestalt principles). Another concept introduced was “polarity” which specifies that connections occur more easily in the direction in which they were originally formed than the opposite. Thorndike also introduced the “spread of effect” idea, i.e., rewards affect not only the connection that produced them but temporally adjacent connections as well.

Application

Connectionism was meant to be a general theory of learning for animals and humans. Thorndike was especially interested in the application of his theory to education including mathematics (Thorndike, 1922), spelling and reading (Thorndike, 1921),

measurement of intelligence (Thorndike et al., 1927) and adult learning (Thorndike at al., 1928).

Example

The classic example of Thorndike's S-R theory was a cat learning to escape from a "puzzle box" by pressing a lever inside the box. After much trial and error behavior, the cat learns to associate pressing the lever (S) with opening the door (R). This S-R connection is established because it results in a satisfying state of affairs (escape from the box). The law of exercise specifies that the connection was established because the S-R pairing occurred many times (the law of effect) and was rewarded (law of effect) as well as forming a single sequence (law of readiness).

Fundamental theories: Guthrie

Guthrie attempted to explain learning through **association** of stimuli with responses.

Learning, in terms of behavior is a function of the environment. According to Guthrie, learning is associating a particular stimulus with a particular response. This association, however, will only occur if **stimuli and responses occur soon enough** one after another (**the contiguity law**). The association is established on the **first experienced instance of the stimulus** (**one trial learning**). Repetitions or **reinforcements** in terms of reward or punishment do not influence the strength of this connection. Still, every stimulus is a bit different, which results in many trials in order to form a general response. This was according to Guthrie the only

type of learning identifying him not as reinforcement theorist, but contiguity theorist.

More complex behaviors are composed of a **series of movements** (habits where each movement is a small stimulus-response combination. This movements or are actually what is being learned in each one trial learning rather than behaviors. Learning a number of moves forms an act (incremental learning). Unsuccessful acts remain not learned because they are replaced by later successfully learned acts.

Other researchers like John Watson studied whole acts just because it was easier, but movements are, according to Guthrie what should actually be studied.

Forgetting occurs not due to time passage, but due to interference. As time passes, stimulus can become associated with new responses. Three different methods can help in forgetting an undesirable old habit and help replacing it

- **Fatigue method** - using numerous repetitions, an animal becomes so fatigued that it is unable to reproduce the old response, and introduces a new response (or simply doesn't react).
- **Threshold method** - first, a very mild version of the stimulus below the threshold level is introduced. Its intensity is then slowly increased until the full stimulus can be tolerated without causing the undesirable response
- **Incompatible stimuli method** - the response is “unlearned” by placing the animal in a situation where it cannot exhibit the undesirable response.

Although it was intended to be a general theory of learning, Guthrie's theory was tested mostly on animals.

What is the practical meaning of contiguity theory and one trial learning?

In Guthrie's own words, “we learn only what we ourselves do”.

Learning must be active, but as such must involve both **teacher's and students' activity** in order to relate stimulus with a response within a time limit. Guthrie also applied his ideas to treatment of **personality disorders**.

Criticisms

Guthrie's theory was first preferred, due to its **simplicity**, but later criticized for the same reason. Its simplicity was later turned into **incompleteness**. It was also based on too little experimental data and criticized for being unable to explain why people often behave differently in same situations

Guthrie’s contiguity theory specifies that “a combination of stimuli which has accompanied a movement will on its recurrence tend to be followed by that movement”. According to Guthrie, all learning was a consequence of association between a particular stimulus and response. Furthermore, Guthrie argued that stimuli and responses affect specific sensory-motor patterns; what is learned are movements, not behaviors.

In contiguity theory, rewards or punishment play no significant role in learning since they occur after the association between stimulus and response has been made. Learning takes place in a single trial (all or none). However, since each stimulus pattern is slightly

different, many trials may be necessary to produce a general response. One interesting principle that arises from this position is called “postremity” which specifies that we always learn the last thing we do in response to a specific stimulus situation.

Contiguity theory suggests that forgetting is due to interference rather than the passage of time; stimuli become associated with new responses. Previous conditioning can also be changed by being associated with inhibiting responses such as fear or fatigue. The role of motivation is to create a state of arousal and activity which produces responses that can be conditioned.

Application

Contiguity theory is intended to be a general theory of learning, although most of the research supporting the theory was done with animals. Guthrie did apply his framework to personality disorders (e.g. Guthrie, 1938).

Example

The classic experimental paradigm for Contiguity theory is cats learning to escape from a puzzle box (Guthrie & Horton, 1946). Guthrie used a glass paneled box that allowed him to photograph the exact movements of cats. These photographs showed that cats learned to repeat the same sequence of movements associated with the preceding escape from the box. Improvement comes about because irrelevant movements are unlearned or not included in successive associations.

Principles

1. In order for conditioning to occur, the organism must actively respond (i.e., do things).
2. Since learning involves the conditioning of specific movements, instruction must present very specific tasks.
3. Exposure to many variations in stimulus patterns is desirable in order to produce a generalized response.
4. The last response in a learning situation should be correct since it is the one that will be associated.

Hull - learning theory

INTRODUCTION

Learning is one of the most important topics in present-day psychology, yet it is an extremely difficult concept to define. Learning occupies a very important place in our life. Most of what we do or do not do is influenced by what we learnt it. Learning therefore provides a key to the structure of our personality and behavior. An individual starts to learning immediately after his birth or in a strict sense even in womb of the mother. Experience direct or indirect is found to play a dominant role in molding and shaping our behavior of the individual from the very beginning. The change in behavior brought about by experience is commonly known as learning. In this way, the term learning broadly speaking, stands for all those changes and modifications in the behavior of the individual which he undergoes during his life time.

DEFINITION

Gardner Murphy (1968)

The term learning covers every modification in behavior to meet environmental requirements.

Henry P. Smith (1962)

Learning is the acquisition of new behavior or the strengthening or weakening of old behavior as the result of experience.

Crow and Crow (1973)

Learning is the acquisition of habits, knowledge and attitudes. It involves new ways of doing things, and it operates in an individual's attempts to overcome obstacles or to adjust to new situation. It represents progressive changes in behavior. It enables him to satisfy interests to attain goals.

Kimble (1961)

Learning is a relatively permanent change in behavioral potentiality that occurs as a result of reinforced practice.

The above definition reveals the following facts:

1. Learning is a process and not a product.

2. It involves all those experience and training of an individual (right from birth) which help him to produce changes in his behavior

3. Learning leads to changes in behavior but this does not necessarily mean that these changes always bring about improvement or positive development. One has an equal chance to drift to the negative side of human personality.

4. Learning prepares an individual for any adjustment and adaptation that may be necessary

Clark Hull grew up handicapped and contracted polio at the age of 24, yet he became one of the great contributors to psychology. His family was not well off so his education had to be stopped at times. Clark earned extra money through teaching. Originally Clark aspired to be a great engineer, but that was before he fell in love with the field of Psychology.

By the age of 29 he graduated from Michigan University.

When Clark was 34 when he received his Ph.D. in Psychology at the University of Wisconsin in 1918.

Soon after graduation he became a member of the faculty at the University of Wisconsin, where he served for 10 years. Although one of his first experiments was an analytical study of the effects of tobacco on behavioral efficiency, his lifelong emphasis was on the development of objective methods for psychological studies designed to determine the underlying principles of behavior.

Hull devoted the next 10 years to the study of hypnosis and suggestibility, and in 1933 he published Hypnosis and Suggestibility, while employed as a research professor at Yale University. This is where he developed his major contribution, an elaborate theory of behavior based on Pavlov's laws of conditioning. Pavlov provoked Hull to become greatly interested in the problem of conditioned reflexes and learning. In 1943 Hull published, Principles of Behavior, which presented a number of constructs in a detailed Theory of Behavior. Soon he became the most cited psychologist. For his effort, Hull received the Warren medal in 1945 from the society of Experimental Psychology. Hull was physically disabled most of his life. In 1948 he had coronary attack, and four years later he died. In his last book he wrote (A behavior system), he

expressed regret that the third book that he had intended to write on learning would never be written.

HULL LEARNING THEORY

1. DERIVE REDUCTION THEORY

Drive Reduction Theory - the notion that behavior occurs in response to "drives" such as hunger, thirst, sexual interest, feeling cold, etc. When the goal of the drive is attained (food, water, mating, warmth) the drive is reduced, and this constitutes reinforcement of the behaviors that lead to the drive reduction, and ultimately learning.

Hull viewed the drive as a stimulus, arising from a tissue need, which in turn stimulates behavior. The strength of the drive is determined upon the length of the deprivation, or the intensity / strength of the resulting behavior. He believed the drive to be non-specific, which means that the drive does not direct behavior rather it functions to energize it. In addition this drive reduction is the reinforcement.

Hull's learning theory focuses mainly on the principle of reinforcement; when an S-R relationship is followed by a reduction of the need, the probability increases that in future similar situations the same stimulus will create the same prior response. Reinforcement can be defined in terms of reduction of a primary need. Just as Hull believed that there were secondary drives, he also felt that there were secondary reinforcements - “If the intensity of the stimulus is reduced as the result of a secondary or learned

drive, it will act as a secondary reinforcement" (Schultz & Schultz, 1987, p 241). The way to strengthen the S-R response is to increase the number of reinforcements, habit strength.

1. Change in the traditional S-R notion

Hull introduced concept of intervening variables between S and R. Accordingly, when a stimulus(S) impinges on the organism, it results in a sensory neural impulse(s) a kind of stimulus trace. This stimulus trace ultimately causes a motor neural reaction(r) those results in an overt response (R). Thus we may have the formula S-s-r-R instead of the traditional S-R. However, there are so many other things within the inner mechanism of the organism like his interest, needs and drives also the reinforcing mechanism that may influence his response or behavior.

The link between the S-R relationships could be anything that might affect how an organism responds; learning, fatigue, disease, injury, motivation, etc. He labeled this relationship as "E", a reaction potential, or as **sEr**. Clark goal was to make a science out of all of these intervening factors. He classified his formula.

The concept of Drive Stimuli Reduction

Originally, Hull had a drive reduction theory of learning, but later he revised it to a Drive Stimuli Reduction theory of learning. One reason for the change was the realization that if a thirsty animal is given water as a reinforce for performing some act, it takes a considerable amount of time for the thirst drive to be satisfied by the water. The water goes into the mouth, the throat, the stomach, and eventually the blood. The effects of ingestion of water must ultimately reach the brain, and finally the thirst drive will be reduced.

Hull concluded that the drive reduction was too far removed from the presentation of the reinforce to explain how learning could take place. What was needed to explain learning was something that occurred soon after the presentation of a reinforce, and that something was the reduction of drive stimuli (SD).

REASONS

1. Drive stimuli for thirst include dryness in the mouth and parched lips. Water almost immediately reduces such stimulation thus hull had the mechanism he needed for explaining learning.

2. It was provided by Sheffield and Roby (1950), who found that hungry rats were reinforced by non- nutritive saccharine, which could not possibly have reduced the hunger drive.

Incentive motivation (K)

Results found by Crepsi and Zeaman led hull to reach the conclusion that organism learn as rapidly for a small incentive as they do for large one, but they perform differently as size of the incentive (K) varies. The rapid change in performance following a change in reinforcement size is referred to as the **Crepsi effect**, after the man who first observed it.

Stimulus-Intensity Dynamism

According to hull, Stimulus-Intensity Dynamism (V) is an intervening variable that varies along with the intensity of the external

stimulus(S). Stated simply, Stimulus-Intensity Dynamism indicates that the greater the intensity of a stimulus, the greater the probability that a learned response will be elicited. Thus we must revise hull's earlier formula as follows

sEr = (sHr x D x K x V) - (sIr + Ir) – sOr

It is interesting to note that because **sHr , D, K and V** are multiplied together, if any one had a value of zero, reaction potential would be zero. For example there could have been many pairings between S and R (sHr), but if drive is zero, reinforcement is zero or the organism cannot detect the stimulus, a learned response will not occur.

Hull's final system summarized

There are three kinds of variable in hull's theory:

1. **Independent variable** –which are stimulus events systematically manipulated by the experimenter.

2. **Intervening variables** – which are process thought to be taking place within the organism but directly observable.

3. **Dependent variables** – which are some aspect of behavior that is measured by the experimenter in order to determine whether the independent variables had any effect.

EDUCATIONAL IMPLICATION

The development of curriculum

In this reference hull emphasized the importance of needs in learning process and accordingly the needs of all categories of children should be incorporated in the curriculum learning becomes meaningful only when it satisfies the needs of children.

The know actual needs of the students by teacher and parents

Hull is fells that teachers and parents of the student should also share their responsibility in teaching the actual needs of the student through various means proper guidance is must for their attitude and aptitudes.

Emphasized anxiety as a drive in human learning

From this line of reasoning, it follows that encouraging some anxiety in students that could subsequently be reduced by success is a necessary condition for classroom learning. Too little anxiety results in no learning (because there is no drive to be reduced), and too much anxiety is disruptive. Therefore, students who are mildly anxious are in the best position to learn and are therefore easiest to teach.

Hull's system of learning advocated the following chain sequence for improved results in the teaching-learning process:

a. Drive – This is something which is needed by the learner in order to behave or respond.

b. Cue – There must be something to which the learner must respond.

c. Response – The learner must be made to respond in order to learn some act.

d. Reward – The learner's response must be reinforced or rewarded, thus enabling him to learn what he wants to learn.

Hull developed a version of behaviorism in which the stimulus (S) affects the organism (O) and the resulting response (R) depends upon characteristics of both O and S. In other words, Hull was interested in studying intervening variables that affected behavior such as initial drive, incentives, inhibitors, and prior training (habit strength). Like other forms of behavior theory, reinforcement is the primary factor that determines learning. However, in Hull's theory, drive reduction or need satisfaction plays a much more important role in behavior than in other frameworks (i.e., connectionism, operant conditioning).

Hull's theoretical framework consisted of many postulates stated in mathematical form; They include:

(1) organisms possess a hierarchy of needs which are aroused under conditions of stimulation and drive,

(2) habit strength increases with activities that are associated with primary or secondary reinforcement,

(3) habit strength aroused by a stimulus other than the one originally conditioned depends upon the closeness of the second stimulus in terms of discrimination thresholds,

(4) stimuli associated with the cessation of a response become conditioned inhibitors,

(5) the more the effective reaction potential exceeds the reaction theshold, the shorter the latency of response. As these postulates

indicate, Hull proposed many types of variables that accounted for generalization, motivation, and variability (oscillation) in learning.

One of the most important concepts in Hull's theory was the habit strength hierarchy: for a given stimulus, an organism can respond in a number of ways. The likelihood of a specific response has a probability which can be changed by reward and is affected by various other variables (e.g. inhibition). In some respects, habit strength hierarchies resemble components of cognitive theories such as schema and production systems .

Application

Hull's theory is meant to be a general theory of learning. Most of the research underlying the theory was done with animals, except for Hull et al. (1940) which focused on verbal learning. Miller & Dollard (1941) represents an attempt to apply the theory to a broader range of learning phenomena. As an interesting aside, Hull began his career researching hypnosis – an area that landed him in some controversy at Yale (Hull, 1933).

Example

Here is an example described by Miller & Dollard (1941): A six year old girl who is hungry and wants candy is told that there is candy hidden under one of the books in a bookcase. The girl begins to pull out books in a random manner until she finally finds the correct book (210 seconds). She is sent out of the room and a new piece of candy is hidden under the same book. In her next search, she is much more directed and finds the candy in 86 seconds. By the ninth repetition of this experiment, the girl finds the candy immediately (2 seconds). The girl exhibited a drive for the candy and looking under

books represented her responses to reduce this drive. When she eventually found the correct book, this particular response was rewarded, forming a habit. On subsequent trials, the strength of this habit was increased until it became a single stimulus-response connection in this setting.

Principles

1. Drive is essential in order for responses to occur (i.e., the student must want to learn).
2. Stimuli and responses must be detected by the organism in order for conditioning to occur (i.e., the student must be attentive).
3. Response must be made in order for conditioning to occur (i.e., the student must be active).
4. Conditioning only occurs if the reinforcement satisfied a need (i.e, the learning must satisfy the learner's wants).

CONCLUSION

Hull's system of learning is acclaimed and remembered for putting forward a most systematic, scientific and mathematical theory of learning. Hull was able to popularize a very innovative and objective behavioristic approach to learning which was more effective in comparison to the approach of his predecessors. The greatest contribution of hull's theory lies in its emphasis on linking the learning to the needs of the children.

He says that it is the need, drive or drive stimuli that energies an individual to act or learn or behave. Therefore, he advocated the need-based goals of education, including need-based curricula and

methods of teaching. Whereas needs start the process of learning, reinforcement and incentives act as catalytic agents for increasing one's efforts towards achieving the goals of learning.

Therefore in any education process we must involve sufficient possibilities of proper motivation and reinforcement incentives.

Classical Conditioning: Procedure, phenomena and related issues

Classical conditioning (also known as Pavlovian conditioning) is learning through association and was discovered by Pavlov, a Russian physiologist. In simple terms, two stimuli are linked together to produce a new learned response in a person or animal.

John Watson proposed that the process of classical conditioning (based on Pavlov's observations) was able to explain all aspects of human psychology.

Everything from speech to emotional responses was simply patterns of stimulus and response. Watson denied completely the existence of the mind or consciousness. Watson believed that all individual differences in behavior were due to different experiences of learning.

Stage 1: Before Conditioning:

In this stage, the unconditioned stimulus (UCS) produces an unconditioned response (UCR) in an organism.

In basic terms, this means that a stimulus in the environment has produced a behavior / response which is unlearned (i.e., unconditioned) and therefore is a natural response which has not been taught. In this respect, no new behavior has been learned yet.

This stage also involves another stimulus which has no effect on a person and is called the neutral stimulus (NS). The NS could be a person, object, place, etc.

The neutral stimulus in classical conditioning does not produce a response until it is paired with the unconditioned stimulus.

During Conditioning:

During this stage, a stimulus which produces no response (i.e., neutral) is associated with the unconditioned stimulus at which point it now becomes known as the conditioned stimulus (CS).

For example, a stomach virus (UCS) might be associated with eating a certain food such as chocolate (CS). Also, perfume (UCS) might be associated with a specific person (CS).

For classical conditioning to be effective, the conditioned stimulus should occur before the unconditioned stimulus, rather than after it, or during the same time. Thus, the conditioned stimulus acts as a type of signal or cue for the unconditioned stimulus.

After Conditioning:

Now the conditioned stimulus (CS) has been associated with the unconditioned stimulus (UCS) to create a new conditioned response (CR).

For example, a person (CS) who has been associated with nice perfume (UCS) is now found attractive (CR). Also, chocolate (CS) which was eaten before a person was sick with a virus (UCS) now produces a response of nausea (CR).

Classical Conditioning in the Classroom

The implications of classical conditioning in the classroom are less important than those of operant conditioning, but there is a still need for teachers to try to make sure that students associate positive emotional experiences with learning.

If a student associates negative emotional experiences with school, then this can obviously have bad results, such as creating a school phobia.

For example, if a student is bullied at school they may learn to associate the school with fear. It could also explain why some students show a particular dislike of certain subjects that continue throughout their academic career. This could happen if a student is humiliated or punished in class by a teacher.

Critical Evaluation

Classical conditioning emphasizes the importance of learning from the environment, and supports nurture over nature. However, it is limiting to describe behavior solely in terms of either nature or nurture, and attempts to do this underestimate the complexity of human behavior. It is more likely that behavior is due to an interaction between nature (biology) and nurture (environment).

A strength of classical conditioning theory is that it is scientific. This is because it's based on empirical evidence carried out by controlled

experiments. For example, Pavlov (1902) showed how classical conditioning could be used to make a dog salivate to the sound of a bell.

Classical conditioning is also a reductionist explanation of behavior. This is because a complex behavior is broken down into smaller stimulus-response units of behavior.

Supporters of a reductionist approach say that it is scientific. Breaking complicated behaviors down to small parts means that they can be scientifically tested. However, some would argue that the reductionist view lacks validity. Thus, while reductionism is useful, it can lead to incomplete explanations.

A final criticism of classical conditioning theory is that it is deterministic. This means that it does not allow for any degree of free will in the individual. Accordingly, a person has no control over the reactions they have learned from classical conditioning, such as a phobia.

Basic Principles of Classical Conditioning

Classical conditioning is a form of learning whereby a conditioned stimulus (CS) becomes associated with an unrelated unconditioned stimulus (US) in order to produce a behavioral response known as a conditioned response (CR). The conditioned response is the learned response to the previously neutral stimulus. The unconditioned stimulus is usually a biologically significant stimulus such as food or pain that elicits an unconditioned response (UR) from the start. The conditioned stimulus is usually neutral and produces no particular response at first, but after conditioning it elicits the conditioned response.

Extinction is the decrease in the conditioned response when the unconditioned stimulus is no longer presented with the conditioned stimulus. When presented with the conditioned stimulus alone, the individual would show a weaker and weaker response, and finally no response. In classical-conditioning terms, there is a gradual weakening and disappearance of the conditioned response. Related to this, spontaneous recovery refers to the return of a previously extinguished conditioned response following a rest period. Research has found that with repeated extinction/recovery cycles, the conditioned response tends to be less intense with each period of recovery.

Pavlov's Famous Study

The best-known of Pavlov's experiments involves the study of the salivation of dogs. Pavlov was originally studying the saliva of dogs as it related to digestion, but as he conducted his research, he noticed that the dogs would begin to salivate every time he entered the room—even if he had no food. The dogs were associating his entrance into the room with being fed. This led Pavlov to design a series of experiments in which he used various sound objects, such as a buzzer, to condition the salivation response in dogs.

He started by sounding a buzzer each time food was given to the dogs and found that the dogs would start salivating immediately after hearing the buzzer—even before seeing the food. After a period of time, Pavlov began sounding the buzzer without giving any food at all and found that the dogs continued to salivate at the sound of the buzzer even in the absence of food. They had learned to associate the sound of the buzzer with being fed.

If we look at Pavlov's experiment, we can identify the four factors of classical conditioning at work:

- The unconditioned response was the dogs' natural salivation in response to seeing or smelling their food.
- The unconditioned stimulus was the sight or smell of the food itself.
- The conditioned stimulus was the ringing of the bell, which previously had no association with food.
- The conditioned response, therefore, was the salivation of the dogs in response to the ringing of the bell, even when no food was present.

Pavlov had successfully associated an unconditioned response (natural salivation in response to food) with a conditioned stimulus (a buzzer), eventually creating a conditioned response (salivation in response to a buzzer). With these results, Pavlov established his theory of classical conditioning.

Neurological Response to Conditioning

Consider how the conditioned response occurs in the brain. When a dog sees food, the visual and olfactory stimuli send information to the brain through their respective neural pathways, ultimately activating the salivation glands to secrete saliva. This reaction is a natural biological process as saliva aids in the digestion of food. When a dog hears a buzzer and at the same time sees food, the auditory stimulus activates the associated neural pathways. However, because these pathways are being activated at the same time as the other neural pathways, there are weak synapse

reactions that occur between the auditory stimulus and the behavioral response. Over time, these synapses are strengthened so that it only takes the sound of a buzzer (or a bell) to activate the pathway leading to salivation.

Behaviorism and Other Research

Pavlov's research contributed to other studies and theories in behaviorism, which is an approach to psychology interested in observable behaviors rather than the inner workings of the mind. The philosopher Bertrand Russell argued that Pavlov's work was an important contribution to a philosophy of mind. Pavlov's research also contributed to Hans Eysench's personality theory of introversion and extroversion. Eysench built upon Pavlov's research on dogs, hypothesizing that the differences in arousal that the dogs displayed was due to inborn genetic differences. Eysench then extended the research to human personality traits.

Pavlov's research further led to the development of important behavior-therapy techniques, such as flooding and desensitizing, for individuals who struggle with fear and anxiety. Desensitizing is a kind of reverse conditioning in which an individual is repeatedly exposed to the thing that is causing the anxiety. Flooding is similar in that it exposes an individual to the thing causing the anxiety, but it does so in a more intense and prolonged way.

Classical Conditioning in Humans

The influence of classical conditioning can be seen in responses such as phobias, disgust, nausea, anger, and sexual arousal. A familiar example is conditioned nausea, in which the sight or smell of a particular food causes nausea because it caused stomach

upset in the past. Similarly, when the sight of a dog has been associated with a memory of being bitten, the result may be a conditioned fear of dogs.

As an adaptive mechanism, conditioning helps shield an individual from harm or prepare them for important biological events, such as sexual activity. Thus, a stimulus that has occurred before sexual interaction comes to cause sexual arousal, which prepares the individual for sexual contact. For example, sexual arousal has been conditioned in human subjects by pairing a stimulus like a picture of a jar of pennies with views of an erotic film clip. Similar experiments involving blue gourami fish and domesticated quail have shown that such conditioning can increase the number of offspring. These results suggest that conditioning techniques might help to increase fertility rates in infertile individuals and endangered species.

Issues

Classical conditioning is one of those introductory psychology terms that gets thrown around. Many people have a general idea that it is one of the most basic forms of associative learning, and people often know that Ivan Pavlov's 1927 experiment with dogs has something to do with it, but that is often where it ends.

Classical Conditioning, Explained

The most important thing to remember is that classical conditioning involves automatic or reflexive responses, and not voluntary behavior (that's operant conditioning, and that is a different post). What does this mean? For one thing, that means that the only responses that can be elicited out of a classical conditioning paradigm are ones that rely on responses that are naturally made

by the animal (or human) that is being trained. Also, it means that the response you hope to elicit must occur below the level of conscious awareness - for example, salivation, nausea, increased or decreased heartrate, pupil dilation or constriction, or even a reflexive motor response (such as recoiling from a painful stimulus). In other words, these sorts of responses are involuntary.

The basic classical conditioning procedure goes like this: a neutral stimulus is paired with an unconditional stimulus (UCS). The neutral stimulus can be anything, as long as it does not provoke any sort of response in the organism. On the other hand, the unconditional stimulus is something that reliably results in a natural response. For example, if you shine a light into a human eye, the pupil will automatically constrict (you can actually see this happen if you watch your eyes in a mirror as you turn on and off a light). Pavlov called this the "unconditional response." (UCR)

As soon as the neutral stimulus is presented with the UCS, it becomes a conditional stimulus (CS). If the CS and UCS always occur together, then the two stimuli would become associated over time. The response that was initially produced in response to the UCS would also be produced in response to the CS, even if it was presented alone. Pavlov called this the "conditional response." (CR)

To make this a bit more concrete, we'll use Pavlov's dogs as an example. Before learning took place, the dogs would reliably salivate (UCR) when given meat powder (UCS), but they gave no response to the ringing of a bell (neutral). Then Pavlov would always ring a bell just before he would present the dogs with some meat powder. Pretty soon, the dogs began to associate the sound of the bell with the impending presence of meat powder. As a result,

they would begin to salivate (CR) as soon as they heard the bell (CS), even if it was not immediately followed by the meat powder (UCS). In other words, they learned that the bell was a reliable predictor of meat powder. In this way, Pavlov was able to elicit an involuntary, automatic, reflexive response to a previously neutral stimulus.

Classical conditioning can help us understand how some forms of **addiction**, or drug dependence, work. For example, the repeated use of a drug could cause the body to compensate for it, in an effort to counterbalance the effects of the drug. This causes the user to require more of the substance in order to get the equivalent effect (this is called tolerance). However, the development of tolerance also takes into account other environmental variables (the conditional variables) - this is called the situational specificity of tolerance. For example, alcohol tends to taste a certain way, and when alcohol is consumed in the usual way, the body responds in an effort to counteract the effect. But, if the alcohol is delivered in a novel way (such as in Four Loko), the individual could overdose. This effect has also been observed among those who have become tolerant to otherwise lethal amounts of opiates: they may experience an overdose if they take their typical dose in an atypical setting. These results have been found in species ranging from rats and mice to humans.

In these examples, it's the environmental context (conditional stimuli) that prompts the body to prepare for the drug (the conditional response). But if the conditional stimuli are absent, the body is not able to adequately prepare itself for the drug, and bad things could happen.

Another example of classical conditioning is known as the **appetizer effect**. If there are otherwise neutral stimuli that consistently predict a meal, they could cause people to become hungry, because those stimuli induce involuntary changes in the body, as a preparation for digestion. There's a reason it's called the "dinner bell," after all.

Classical conditioning is also being used in **wildlife conservation efforts**! At Extinction Countdown, John Platt pointed out last month that taste aversion, which is a form of classical conditioning, is being used to keep lions from preying on cattle. This should, in turn, prevent farmers from killing the lions.

Instrumental learning: Phenomena, Paradigms and theoretical issues;

Introduction To Instrumental Conditioning

We now shift from the topic of classical conditioning to that of **instrumental** (or as Skinner terms it, **operant**) **conditioning**. This topic will prove a bit more complex in its findings. As you will see, however, many of the ideas that were important in classical conditioning will prove relevant here. Indeed, there has long been a debate over whether classical and operant conditioning ought to be regarded as truly different forms of learning. They appear to differ in the sense that classical conditioning generally involves the presence of **reflex actions**, whereas instrumental conditioning generally involves modifications of **voluntary behavior** contingent on presence of **reinforcers** or **punishers**. Whether that is a sufficient reason to distinguish them is arguable, as we will see later. My sense of the field today is that most theorists would like to see similar theories explain the results in both. Thus, it will not surprise you, for example, that a modified version of the Rescorla-

Wagner model has also been proposed for instrumental conditioning.

Two Early Views Of Instrumental Conditioning

We will look at two quite different claims about the nature of instrumental conditioning. One comes from **Watson**, the author of the 1913 behaviorist manifesto, Psychology as the behaviorist views it, and the second comes from **Thorndike**, who can probably safely be credited with conducting the first truly sophisticated and careful observations of complex animal learning. Their accounts differ in ways that prefigured an important debate about what was needed for learning to occur.

First, however, let us distinguish instrumental conditioning from classical conditioning. In instrumental conditioning, an animal makes one of a number of possible responses in the presence of some stimulus complex or context. That response may lead to some outcome. We typically define learning in this circumstance as an alteration in some observed characteristic of the response such as its frequency, latency, or amplitude. We will revisit this definition in more detail later, once we have examined several theories of what gets acquired, and why. For now, we can talk about instrumental conditioning as the type of learning involved in navigating a maze, choosing the correct one of several doors to run to, or even performing some response that will be successful in avoiding a future shock. In instrumental conditioning, **new** responses may be taught that differ from any reflexive response already in the animal's behavioral repertoire.

Basic Paradigms

We have already introduced two general paradigms involving acquisition and extinction. In acquisition, an outcome is typically paired with making a response in the presence of a stimulus; in extinction, that pairing typically ceases. Within this broad framework (particularly with respect to acquisition), we may distinguish several additional paradigms.

In **appetitive** or **approach learning**, the animal makes a response that results in a desired reward. This is the type of learning involving reinforcement that we have implicitly and explicitly discussed so far. But it is not the only paradigm based on reinforcement. Another that deserves particular note is **omission training**, in which an animal has to suppress or withhold a response in order to get its reward. **Sheffield**, for example, trained dogs to salivate in the presence of a tone associated with food, and then shifted them to omission training. In this latter phase, the dogs had to avoid salivating to the tone for several seconds to get the food. Omission training is initially typically difficult, and displays a relatively slow learning curve. However, there are several studies suggesting that in the long run, it will be as effective as extinction in decreasing the frequency of a response. Omission training is sometimes referred to as negative punishment to indicate that making the response is associated with removal of a reinforcer (which thus acts as a punishment).

Another paradigm based on reinforcement is **escape learning**. In escape learning, the animal learns a response that gets it away from punishment, either by turning off the punisher, or by allowing the animal to leave the area where the punishment was administered. Escape learning is closely associated with another paradigm, **avoidance learning**. In avoidance learning, the

punishment is intermittent rather than continuous. If the animal makes the proper response before the punishment comes on, it will succeed in canceling that punishment. In avoidance learning, animals typically start out by escaping the aversive stimulation (making a response during the punishment that stops it), and then come to make the response early enough that they subsequently successfully avoid the aversive stimulation.

Punishment training (or **aversive learning**), of course, involves the administration of an unpleasant, aversive outcome following a response. Thus, punishment training, omission training, and extinction all have in common reducing the level of a given response, whereas appetitive learning, escape learning, and avoidance learning attempt to increase response level. There are some obvious interplays in paradigms here, depending on which response you focus on. Often, aspects of several different paradigms combine: One response may be punished while another is reinforced.

We may also distinguish between **signaled** and **unsignaled learning**. A discrete, distinct stimulus is present in signaled learning, but not in unsignaled learning. Thus, for example, in unsignaled avoidance, shocks can occur at regular intervals that could be avoided if the animal responds shortly before the shock's onset. There is no physical stimulus signaling the shock; the animal in this case needs to rely on an internal sense of time. In unsignaled conditions, features such as time or the contextual cues presumably act as stimuli.

Another paradigm, **transfer training** will prove important, especially when we focus on discrimination in a later chapter. In

transfer training, we look at the effects of learning one task on another. Transfer might be **nonexistent (zero)**, **positive** (**facilitation**: the learning is faster), or **negative** (**inhibition**: there is interference). In addition, transfer effects might be **proactive** (in which we look at the effect of an earlier task on the learning or performance of a later task), or **retroactive** (in which we saw how the later task influences performance on the earlier one).

A final paradigm involves **shaping**. Normally, approach learning applies to responses that are not especially frequent to start with, since we want to track an increase in frequency as one of our measures of learning. Thus, we find ourselves in the following situation: We sit in the lab, watching our animal subject, waiting for it to make the desired response so that we can administer the reinforcer.

Such a procedure will obviously be inefficient. In some cases (such as a pig rolling a coin), the wait may be very long indeed! Hence, a technology has developed that involves increasing the probability of having the animal emit that response so that we can then train it further through reinforcement. This technology, called shaping, requires **reinforcing successive approximations to the desired response**.

Shaping works as follows. We start out by identifying a high-frequency component of the response we want, and we reinforce that. So, if we want our rat to press a bar on the left side of an experimental chamber, then a high-frequency component would involve having the rat be in the left half of the chamber. While it is exploring its environment, we reinforce for crossing over to the left.

Then, as it increases its time on the left, we drop the reinforcer. That will cause the behavior to become more variable. We await some response yet closer to what we want to train (such as being near the bar), and when that occurs we reintroduce the reinforcer. And then, of course, we cycle the process through again in order to obtain yet a closer approximation (such as touching the bar). Shaping is a very powerful technique, not only because of its ability to 'coax' low frequency responses out of an animal, but also -- and especially -- because of **its ability to mold a response that is not normally part of the animal's repertoire!** Thus, by combining shaping and chaining, instrumental conditioning allows us to train **totally new responses**, rather than just transfer stimulus control of an old response to a new stimulus.

Operant behavior involves adaptation to the consequences of responding; it is the prototype of adaptive behavior during the life of the individual – the ontogenetic equivalent of Darwinian natural selection in phylogeny. Techniques for exploring operant behavior exploded with the invention of the Skinner box and the discovery of the orderly and powerful effects of schedules of reinforcement. In the 1950s and 1960s, much research addressed the limits of operant conditioning and in particular the intimate relationship between the processes underlying operant and classical conditioning. In recent decades, two research areas, interval timing and choice, have dominated the field. We have reviewed these topics and, in addition, discussed post-Skinner developments in the economics of operant behavior. We hope, with this chapter, to have aroused the interest of the reader for this fascinating and lively field of behavioral science.

Instrumental Conditioning of Avoidance. Another important model of learning and stress reactivity derived from research with animals was pioneered by B. F. Skinner (1938; Ferster & Skinner, 1957) in landmark works on “contingencies of reinforcement” affecting the behaviors of animals such as rats and pigeons. Skinner observed that animals tend to increase the rate of behaviors that are followed by certain changes in their environment.

He called this phenomenon “reinforcement” that occurs due to the animal’s learning that there is a “contingent” relationship between doing that behavior (e.g., pecking or pushing a lever in the cage) and receiving a desired outcome (the reinforce—for example, a pellet of food). Behavior that might previously have been rare or sporadic can become regular and frequent if the contingency of reinforcement is set up to teach the animal that the behavior seems to produce the reinforcer.

This is another form of conditioned learning, which is called instrumental conditioning because the animal learns that a behavior is “instrumental” in increasing the likelihood that a reinforcer will occur.

“Operant conditioning” does not refer to a single therapeutic technique. Instead, the term refers to an important form of learning, or conditioning, in which behavior is primarily controlled by its consequences. The consequences of a particular kind of behavior in one setting can either increase or decrease the probability of such behavior occurring in similar settings in the future. Descriptions of the consequences of behavior, called rules, can have similar effects. A great deal is known concerning how consequences affect behavior, and this knowledge has been put to good use in designing

interventions shown to be effective across a wide range of client populations, behavior problems, and settings.

The Major Phenomena of Instrumental Conditioning

As Skinner noted, classical and instrumental conditioning are different in impor-tant ways: Classical conditioning builds on a response (UR) that's automatically triggered by a stimulus (US); instrumental conditioning involves behaviors that appear to be voluntary. Classical conditioning involves learning about the relation between two stimuli (US and CS); instrumental conditioning involves learning about the relation between a response and a stimulus (the operant and a reward). Even with these differences, modern theorists have argued that the two forms of conditioning have a lot in common. This makes sense because both involve learning about relationships among simple events (stimuli or responses).

It's perhaps inevitable, then, that many of the central phenomena of instrumental learning parallel those of classical conditioning. For example, in classical conditioning, learning trials typically involve the presentation of a CS followed by a US. In instrumental conditioning, learning trials typically involve a response by the organ-ism followed by a reward or **reinforcer.** The reinforcement often involves the presenta-tion of something good, such as grain to a hungry pigeon. Alternatively, reinforcement may involve the termination or prevention of something bad, such as the cessation of a loud noise.

In both forms of conditioning, the more such pairings there are, the stronger the learning. And if we discontinue these pairings so that the CS is no longer followed by the US or the response by a reinforcer, the result is extinction.

GENERALIZATION AND DISCRIMINATION

An instrumental response is not directly triggered by an external stimulus, the way a CR or UR is. But that doesn't mean external stimuli have no role here. In instrumental con-ditioning, external events serve as discriminative stimuli, signaling for an animal what sorts of behaviors will be rewarded in a given situation. For example, suppose a pigeon is trained to hop onto a platform to get some grain. When a green light is on, hopping on the platform pays off. But when a red light is on, hopping gains no reward. Under these circumstances, the green light becomes a positive discriminative stimulus and the red light a negative one (usually labeled S^+ and S^-, respectively). The pigeon swiftly learns this pattern and so will hop in the presence of the first and not in the presence of the second.

Other examples are easy to find. A child learns that pinching her sister leads to pun-ishment when her parents are on the scene but may have no consequences otherwise. In this situation, the child may learn to behave well in the presence of the S^+ (i.e., when her parents are there) but not in other circumstances. A hypochondriac may learn that loud groans will garner sympathy and support from others but may bring no benefits when others are not around. As a result, he may learn to groan in social settings but not when alone.

Let's be clear, though, about the comparison between these stimuli and the stimuli central to classical conditioning. A CS^+ tells the animal about events in the world: "No matter what you do, the US is coming." The S^+, on the other hand, tells the animal about the impact of its own behavior: "If you respond now, you'll get rewarded." The CS^- indicates that no matter what the animal does,

no US is coming. The S^-, in con-trast, tells the animal something about its behavior—namely, that there's no point in responding right now.

Despite these differences, generalization in instrumental conditioning functions much the way it does in classical conditioning, and likewise for discrimination. One illustration of these parallels lies in the generalization gradient. We saw earlier that if an organism is trained with one CS (perhaps a high tone) but then tested with a differ-ent one (a low tone), the CR will be diminished. The greater the change in the CS, the greater the drop in the CR's strength. The same pattern emerges in instrumental condi-tioning. In one experiment, pigeons were trained to peck at a key illuminated with yellow light. Later, they were tested with lights of varying wavelengths, and the results showed an orderly generalization gradient (Figure 7.22). As the test light became less similar to the original S^+, the pigeons were less inclined to peck at it (Guttmann & Kalish, 1956).

BEHAVIOR MOTIVATION

Once we've identified a stimulus as a reinforcer, what determines how effective the reinforcer will be? We know that some reinforcers are more powerful than others—and so an animal will respond more strongly for a large reward than for a small one. However, what counts as large or small depends on the context. If a rat is used to get-ting 60 food pellets for a response, then 16 pellets will seem measly and the animal will respond only weakly for this puny reward. But if a rat is used to getting only 4 pellets for a response, then 16 pellets will seem like a feast and the rat's response will be fast and strong (for the classic demonstration of this point, see

Crespi, 1942). Thus, the effectiveness of a reinforcer depends largely on what other rewards are available (or have recently been available); this effect is known as **behavioral contrast.**

Contrast effects are important for their own sake, but they may also help explain another (somewhat controversial) group of findings. In one study, for example, nursery-school children were given an opportunity to draw pictures. The children seemed to enjoy this activity and produced a steady stream of drawings. The experimenters then changed the situation: They introduced an additional reward so that the children now earned an attractive "Good Player" certificate for producing their pictures. Then, later on, the chil-dren were again given the opportunity to draw pictures—but this time with no provision for "Good Player" rewards. Remarkably, these children showed considerably less interest in drawing than they had at the start and chose instead to spend their time on other activ-ities (see, for example, Lepper, Greene, & Nisbett, 1973; also Kohn, 1993).

Some theorists say these data illustrate the power of behavioral contrast. At the start of the study, the activity of drawing was presumably maintained by certain reinforce-ments in the situation—perhaps encouragement from the teachers or comments by other children. Whatever the reinforcements were, they were strong enough to maintain the behavior; we know this because the children were producing drawings at a steady pace. Later on, though, an additional reinforcement (the "Good Player" certifi-cate) was added and then removed. At that point the children were back to the same rewards they'd been getting at the start, but now these rewards

seemed puny in com-parison to the greater prize they'd been earning during the time when the "Good Player" award was available. As a consequence, the initial set of rewards was no longer enough to motivate continued drawing.

Other theorists interpret these findings differently. In their view, results like this one suggest that there are actually two different types of reward. One type is merely tacked onto a behavior and is under the experimenter's control; it's the sort of reward that's in play when we give a pigeon a bit of food for pecking a key, or hand a factory worker a paycheck for completing a day's work. The other type of reward is intrinsic to the behav-ior and independent of the experimenter's intentions; these rewards are in play when someone is engaging in an activity just for the pleasure of the activity itself.

In addition, these two forms of reward can interfere with each other. Thus, in the study with the "Good Player" certificates, the children were initially drawing pictures for an intrinsic reward. Drawing, in other words, was a form of play engaged in for its own sake. However, once the external rewards (the certificates) entered the situation, the same activity became a form of work—something you do for a payoff. And once the

activity was redefined in this way, then the absence of a payoff meant there was no longer any point in drawing.

Debate continues about which of these interpretations is preferable—the one based on behavioral contrast or the one based on intrinsic motivation. (It also seems plausi-ble that both interpretations may capture aspects of what's going on here.) Clearly, there's more to be learned about reinforcement and the nature of motivation. (For further exploration, see Bowles, 2008;

Deci, Koestner, & Ryan, 1999a, 1999b; Eisenberger, Pierce, & Cameron, 1999; Henderlong & Lepper, 2002.)

Reinforcement-Based Learning

Rewards and punishers, in contrast, played a pivotal role in the work of Thorndike, who is often credited with founding the field of instrumental conditioning. Thorndike published a monograph in 1898 on his studies with animals such as cats. He set up an experimental apparatus termed a **puzzle box:** a cage in which the animal was placed, and which could be escaped through the performance of a simple response such as pulling on a rope attached to a door. These studies really involved the first careful, detailed observations of what animals in general learned, as opposed to anecdotal stories collected of amazing things animals did that obviously proved their intelligence. (Television still plays into that sort of approach, needless to say!)

Thorndike asked a very simple question: Would escape from a puzzle box exhibit any signs of intelligence? Would it display evidence of **insight**, in which the animal would be able to glance about its environment, understand that the rope was attached to the door, and realize that it needed only to pull on the rope to get out? To answer this question, Thorndike repeatedly placed animals in the same puzzle box, and measured how long it took them to escape. And what he found was that **the time to escape decreased only gradually**. By the end of the experiment, after 20 or so trials, cats would easily leave the box by performing the appropriate response as soon as they were placed in it. But, their history clearly demonstrated that this had to have been a learned response. In

particular, Thorndike pointed out that an animal making the correct response on a given trial early in training would not necessarily choose that same response as its first response on the next trial. So, rather than insight, he concluded that learning involved **trial-and-error**.

Trial-and-error refers to the gradual accumulation of correct responses through a slow process of trying out all sorts of possibilities, and slowly weeding out the ones that do not work. As did Watson, Thorndike thought animals were acquiring associations between stimulus configurations (such as the puzzle box) and certain responses. But unlike Watson, he claimed that an additional factor was important in the acquisition of these associations: They would depend on the outcome of the animal's actions. This involved a principle Thorndike termed the **Law of Effect**. Put briefly, this law claimed that an association between a stimulus and a response would strengthen if the response were followed by a **satisfactory state of affairs**, and would weaken if the response were followed by an **unsatisfactory state of affairs**. Thus, Thorndike deliberately included Bentham's notion of hedonistic value as a principle governing the formation of an association, in contrast to Watson. Rather than being a simple contiguity theory, this was a **reinforcement theory**: In modern terms, learning of an association will occur when there is a reinforcer following a response.

There are, of course, a number of interpretations available to account for how a reinforcer might operate according to the law of effect. One of the first to come to most people's minds is a **teleological** or **purposive** explanation: The animal performs a response because it desires the outcome. But of course, desiring an

outcome is a mental state that involves an object not present at the time the animal is performing the response. That type of an explanation would violate the positivist program Watson insisted everyone follow. Thus, as an alternative, we might propose that a positive outcome has an automatic effect of strengthening the association: The animal does not perform the response because it wants the outcome, but rather because the response is strongly associated to the stimulus that is present.

Here is what Thorndike actually said regarding satisfying and unsatisfying states (1913, p. 2):

By a satisfying state of affairs is meant one which the animal does nothing to avoid, often doing things which maintain or renew it. By an annoying state of affairs is meant one which the animal does nothing to preserve, often doing things which put an end to it.

Although he was accused of using hopelessly mentalistic terms in describing learning as depending on satisfactory or unsatisfactory states, his actual definition provided a clear behavioral test for determining when one or the other state was present. In that sense, it ought to have troubled people no more than Watson's use of the term "emotional."

Note too that Thorndike did not include the outcome in the association. As we will see, other theorists have claimed that associations to the outcome may also form, so that we can have S-R associations, R-O associations, and even S-O associations. To anticipate how such a model might differ from Thorndike's, a strong S-R association may exist despite a highly unpleasant or unsatisfying outcome: The presence of an R-O association in that

event may serve to inhibit the R excited by presence of an associated stimulus.

Thorndike also proposed another principle, the **Law of Exercise** (sometimes called the **Law of Use**). This was essentially a principle of practice, somewhat similar to Watson's notion of frequency: An association would strengthen if practiced. Both laws were revised in his later work: the Law of Effect was essentially restricted to satisfactory outcomes, and the Law of Use was modified to include outcomes rather than simple exercise.

Thorndike also spoke of the value of different satisfactory states, so that strong satisfiers would do a better job of strengthening an association than weak satisfiers. And as an interesting historical footnote, he actually contradicted one of the major principles of strict contiguity by proposing an early version of belongingness by which some things would be more likely to associate together than others.

In some sense, **Skinner** may be regarded as Thorndike's intellectual successor. Skinner proposed similar ideas involving the **law of reinforcement** and the **law of punishment**. According to Skinner, a **reinforcer** was any event that, following a response, made that response more likely, whereas a punisher was any event that had the opposite effect. To try to identify reinforcers and punishers in a way that wasn't completely circular (and also wasn't mentalistic), Skinner imposed a condition of **transituationality**: A reinforcer or punisher, once identified in terms of its effects on one response, also has to be shown capable of having a similar effect in other situations, on other responses. Otherwise, we find ourselves defining a response as that which, when followed by a

reinforcer, increases in frequency. And that type of definition, of course, reciprocally defines responses and reinforcers in terms of one another in an uninteresting, circular fashion.

With this as background, let us look at some of the basic findings in instrumental conditioning.

Reinforcement: Basic variables

One of the most critical challenges in applied empirical research is to draw causal inference from observational data. Empirical marketing research, which often involves causal analysis of the impact of marketing strategy, is no exception. A central difficulty is endogeneity of variables entering the causal relationship, arising from either omitted variable bias, simultaneity bias, sample selection bias, or measurement errors. According to recent research, mentions of endogeneity and procedures to address it have risen 5x across the field's top four journals (Rutz and Watson (2019)).

Instrumental Variable (IV) methods are among the most frequently used techniques to address such endogeneity issues. Instruments that are correlated with the endogenous variable but are otherwise not associated with the outcome variable can be used to partition the variance of the endogenous variable into endogenous and exogenous components.

The method of instrumental variables is based on using the variation in the exogenous component of the endogenous variable induced by the the variation in the instrumental variable to make inference of causal effects In recent years, use of the IV method has come under criticism in Marketing (e.g. Rossi (2014)) and multiple

other disciplines (e.g. Bound et al. (1995) and Young (2017) in Economics; Yogo (2004), Stock and Yogo (2002), and Hausman et al. (2005) in Finance).

This is because IVs used in practice are often weakly correlated with the endogenous variables, e.g. the instruments used in practice induce limited variation in the endogenous variables leading to impractically large imprecision of estimates of causal effects.

In the extreme case when the correlation becomes sufficiently weak, this leads to a formal “weak instruments” problem whereby standard asymptotics break down, and the estimated parameters are no longer even consistent and have a non-standard asymptotic distribution (see Stock and Wright (2000) and Staiger and Stock (1994)). The bias becomes worse (Hausman et al. (2005)) when the researcher adds more weak instruments.

The problem can be acute for industrial organization models (e.g., Berry et al. (1995), Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998), Hendel and Nevo (2006)), which involve estimating parameters from highly nonlinear functions and makes even the detection of weak IV’s more challenging.

Such models have been widely used in marketing literature and remain the workhorse models for studying many marketing problems (see Goldfarb et al. (2009), Chintagunta and Nair (2011) and many others) Constructing strong and valid instruments is, therefore, an important endeavor for causal inference from observational data. In this paper, we approach the problem of constructing strong instrumental variables from exogenous information in causal models as a (supervised) machine learning problem. We first formulate the choice of construction of instruments

in a causal model as a decision problem that is amenable to the learning approach. The key empirical problem which arises for the econometrician that is distinct from the machine learner is that, in the typical applied context, the econometrician does not have the luxury of treating the sample in-hand as the training sample for the decision problem. Instead, the sample in-hand is typically the only information from which instruments must be constructed and causal inference must simultaneously be derived. We extend the standard learning framework to develop an algorithm we term “MLIV Algorithm”, which allows training of instruments and causal inference to be simultaneously performed from sample data.

Related Literature

As discussed above, the standard existing approach to weak IV concerns is approached through approximation of optimal instruments. Most work on optimal instrument variables in linear models casts the problem as a selection problem among the available exogenous variables (and their transformations e.g., b-splines). Early work on instrument selection goes back to ((Kloek and Mennes 1960) and Amemiya (1966)) where they studied using

“selected” principal components of the many available instruments to counter inference issues due to many instruments. Further work by (Kapetanios and Marcellino (2010)) proposed using factor analysis for decomposing the high-dimensional instruments onto a lowdimensional space.

Both principal component analysis and factor analysis are not targeted at approximating the optimal instruments, but rather at coming up with a low dimensional vector that summarizes the high-dimensional instruments, which could potentially yield (Amemiya

(1966)) better performance in terms of bias and mean squared error. Recent work on instrument selection assumes strong sparsity of the optimal instruments structure (i.e. a small set of the available IVs are valid and sufficient for first stage).

Work by (Bai and Ng (2009)) demonstrate how boosting can be used for recovering the sparse structure but do not provide any formal proof. (Belloni et al. (2012)) explicitly shows how Lasso can be used for instrument selection among a large set of candidate instruments under the strong sparsity assumption. Further they are also able to prove theoretical consistency and other inference results for their IV estimator.

Their proposed approach does not work as well when sparsity is violated, i.e. most instruments are weak, as it selects all of the weak IVs or drops them all. Unlike the extant literature, our learning approach to instrumental variables still exhibits asymptotic guarantees and does not rely on any sparsity assumption on the optimal instrument structure. Further, our approach allows the researcher to apply a broad arsenal of machine learning methods in constructing the instrumental variables.

Reinforcement Schedules

Remember, the best way to teach a person or animal a behavior is to use positive reinforcement. For example, Skinner used positive reinforcement to teach rats to press a lever in a Skinner box. At first, the rat might randomly hit the lever while exploring the box, and out would come a pellet of food. After eating the pellet, what do you think the hungry rat did next? It hit the lever again, and received

another pellet of food. Each time the rat hit the lever, a pellet of food came out. When an organism receives a reinforcer each time it displays a behavior, it is called **continuous reinforcement**. This reinforcement schedule is the quickest way to teach someone a behavior, and it is especially effective in training a new behavior. Let's look back at the dog that was learning to sit earlier in the module. Now, each time he sits, you give him a treat. Timing is important here: you will be most successful if you present the reinforcer immediately after he sits, so that he can make an association between the target behavior (sitting) and the consequence (getting a treat).

Once a behavior is trained, researchers and trainers often turn to another type of reinforcement schedule—partial reinforcement. In **partial reinforcement**, also referred to as intermittent reinforcement, the person or animal does not get reinforced every time they perform the desired behavior. There are several different types of partial reinforcement schedules (Table 1). These schedules are described as either fixed or variable, and as either interval or ratio. Fixed refers to the number of responses between reinforcements, or the amount of time between reinforcements, which is set and unchanging. Variable refers to the number of responses or amount of time between reinforcements, which varies or changes. Interval means the schedule is based on the time between reinforcements, and ratio means the schedule is based on the number of responses between reinforcements.

Reinforcement Schedule	Description	Result
Fixed interval	Reinforcement is delivered at predictable time intervals (e.g., after 5, 10, 15, and 20 minutes).	Moderate response rate with significant pauses after reinforcement
Variable interval	Reinforcement is delivered at unpredictable time intervals (e.g., after 5, 7, 10, and 20 minutes).	Moderate yet steady response rate
Fixed ratio	Reinforcement is delivered after a predictable number of responses	High response rate with pauses after reinforcement

Reinforcement Schedule	Description	Result
	(e.g., after 2, 4, 6, and 8 responses).	
Variable ratio	Reinforcement is delivered after an unpredictable number of responses (e.g., after 1, 4, 5, and 9 responses).	High and steady response rate

Table 1. Reinforcement Schedules

Now let's combine these four terms. A **fixed interval reinforcement schedule** is when behavior is rewarded after a set amount of time. For example, June undergoes major surgery in a hospital. During recovery, she is expected to experience pain and will require prescription medications for pain relief. June is given an IV drip with a patient-controlled painkiller. Her doctor sets a limit: one dose per hour. June pushes a button when pain becomes difficult, and she receives a dose of medication. Since the reward

(pain relief) only occurs on a fixed interval, there is no point in exhibiting the behavior when it will not be rewarded.

With a **variable interval reinforcement schedule**, the person or animal gets the reinforcement based on varying amounts of time, which are unpredictable. Say that Manuel is the manager at a fast-food restaurant. Every once in a while someone from the quality control division comes to Manuel's restaurant. If the restaurant is clean and the service is fast, everyone on that shift earns a $20 bonus. Manuel never knows when the quality control person will show up, so he always tries to keep the restaurant clean and ensures that his employees provide prompt and courteous service. His productivity regarding prompt service and keeping a clean restaurant are steady because he wants his crew to earn the bonus.

With a **fixed ratio reinforcement schedule**, there are a set number of responses that must occur before the behavior is rewarded. Carla sells glasses at an eyeglass store, and she earns a commission every time she sells a pair of glasses. She always tries to sell people more pairs of glasses, including prescription sunglasses or a backup pair, so she can increase her commission. She does not care if the person really needs the prescription sunglasses, Carla just wants her bonus. The quality of what Carla sells does not matter because her commission is not based on quality; it's only based on the number of pairs sold. This distinction in the quality of performance can help determine which reinforcement method is most appropriate for a particular situation. Fixed ratios are better suited to optimize the quantity of output, whereas a fixed interval, in which the reward is not quantity based, can lead to a higher quality of output.

In a **variable ratio reinforcement schedule**, the number of responses needed for a reward varies. This is the most powerful partial reinforcement schedule. An example of the variable ratio reinforcement schedule is gambling. Imagine that Sarah—generally a smart, thrifty woman—visits Las Vegas for the first time. She is not a gambler, but out of curiosity she puts a quarter into the slot machine, and then another, and another. Nothing happens. Two dollars in quarters later, her curiosity is fading, and she is just about to quit. But then, the machine lights up, bells go off, and Sarah gets 50 quarters back. That's more like it! Sarah gets back to inserting quarters with renewed interest, and a few minutes later she has used up all her gains and is $10 in the hole. Now might be a sensible time to quit. And yet, she keeps putting money into the slot machine because she never knows when the next reinforcement is coming. She keeps thinking that with the next quarter she could win $50, or $100, or even more. Because the reinforcement schedule in most types of gambling has a variable ratio schedule, people keep trying and hoping that the next time they will win big. This is one of the reasons that gambling is so addictive—and so resistant to extinction.

Types of Reinforcement Schedules

The two foundational forms of reinforcement schedules are referred to as continuous reinforcement and partial reinforcement.

Continuous Reinforcement

In continuous reinforcement, the desired behavior is reinforced every single time it occurs. [1] This schedule is best used during the initial stages of learning to create a strong association between the behavior and response.

Imagine, for example, that you are trying to teach a dog to shake your hand. During the initial stages of learning, you would stick to a continuous reinforcement schedule to teach and establish the behavior. This might involve grabbing the dog's paw, shaking it, saying "shake," and then offering a reward each and every time you perform these steps. Eventually, the dog will start to perform the action on its own.

Continuous reinforcement schedules are most effective when trying to teach a new behavior. It denotes a pattern to which every narrowly-defined response is followed by a narrowly-defined consequence.

Partial Reinforcement

Once the response is firmly established, a continuous reinforcement schedule is usually switched to a partial reinforcement schedule.[1] In partial (or intermittent) reinforcement, the response is reinforced only part of the time. Learned behaviors are acquired more slowly with partial reinforcement, but the response is more resistant to extinction.

Think of the earlier example in which you were training a dog to shake and. While you initially used continuous reinforcement, reinforcing the behavior every time is simply unrealistic. In time, you would switch to a partial schedule to provide additional reinforcement once the behavior has been established or after considerable time has passed.

There are four schedules of partial reinforcement:

Fixed-Ratio Schedules

Fixed-ratio schedules are those in which a response is reinforced only after a specified number of responses. This schedule produces a high, steady rate of responding with only a brief pause after the delivery of the reinforcer. An example of a fixed-ratio schedule would be delivering a food pellet to a rat after it presses a bar five times.

Variable-Ratio Schedules

Variable-ratio schedules occur when a response is reinforced after an unpredictable number of responses. This schedule creates a high steady rate of responding. Gambling and lottery games are good examples of a reward based on a variable ratio schedule. In a lab setting, this might involve delivering food pellets to a rat after one bar press, again after four bar presses, and then again after two bar presses.

Fixed-Interval Schedules

Fixed-interval schedules are those where the first response is rewarded only after a specified amount of time has elapsed. This schedule causes high amounts of responding near the end of the interval but slower responding immediately after the delivery of the reinforcer. An example of this in a lab setting would be reinforcing a rat with a lab pellet for the first bar press after a 30-second interval has elapsed.

Variable-Interval Schedules

Variable-interval schedules occur when a response is rewarded after an unpredictable amount of time has passed. This schedule produces a slow, steady rate of response.

An example of this would be delivering a food pellet to a rat after the first bar press following a one-minute interval; a second pellet for the first response following a five-minute interval; and a third pellet for the first response following a three-minute interval.

Using the Appropriate Schedule

Deciding when to reinforce a behavior can depend on a number of factors. In cases where you are specifically trying to teach a new behavior, a continuous schedule is often a good choice. Once the behavior has been learned, switching to a partial schedule is often preferable.

In daily life, partial schedules of reinforcement occur much more frequently than do continuous ones. For example, imagine if you received a reward every time you showed up to work on time. Over time, instead of the reward being a positive reinforcement, the denial of the reward could be regarded as negative reinforcement.

Instead, rewards like these are usually doled out on a much less predictable partial reinforcement schedule. Not only are these much more realistic, but they also tend to produce higher response rates while being less susceptible to extinction.[1]

Partial schedules reduce the risk of satiation once a behavior has been established. If a reward is given without end, the subject may stop performing the behavior if the reward is no longer wanted or needed.

For example, imagine that you are trying to teach a dog to sit. If you use food as a reward every time, the dog might stop performing once it is full. In such instances, something like praise or attention

may be more effective in reinforcing an already-established behavior.

Behaviours by reinforcement

Highlights

•

Developmental differences in acquiring and adapting behaviours by reinforcement were examined.

•

Children and adults acquired simple new behaviours by feedback comparably.

•

Children's performance was more disrupted than adults' when adapting behaviours.

•

P3 ERP changes indicated children consolidated adapted behaviours less than adults.

•

FRN ERP changes showed children relied more on feedback than adults in adaptation.

Reinforcement learning in development

The ability to learn and modify behaviours based on the positive and negative outcomes of our actions is an important skill used

throughout the lifespan. This skill, known as reinforcement learning (Holroyd and Coles, 2002, Thorndike and Bruce, 1911), may be particularly valuable in the first two decades of life, affording the naïve developing child an effective method of identifying advantageous behaviours and discerning when and how learned actions should be adapted for changing contexts. Indeed, impaired reinforcement learning has been implicated in the pathology of several neurodevelopmental disorders, including Tourette syndrome and ADHD (Marsh et al., 2004, Sagvolden et al., 2005), although the precise deficits in these conditions are unclear. A thorough understanding of the typical development of reinforcement learning may help clarify these deficits, but few studies have examined this aspect of cognitive development.

1.2. Differences in reinforcement learning across typical development

Previous studies have consistently reported performance differences between children and adults in reinforcement learning. Younger children are less accurate when learning associations between stimuli and responses (S–R associations) by positive and negative feedback than older children and adults (Baldwin et al., 2012, Crone et al., 2004). Children learn at a slower rate than adults (Crone et al., 2004) and show particular difficulties when reinforcements are inconsistent. Specifically, performance differences between children and adults increase when feedback is probabilistic and does not correctly reinforce performance 100% of the time (Eppinger et al., 2009, Hämmerer et al., 2010).

Neural processes underlying these developmental differences have been examined using EEG, particularly the feedback-related

negativity (FRN) event-related potential (ERP). The FRN is a negative deflection in the waveform at ~250 ms following feedback (Miltner et al., 1997). FRN amplitude is larger following negative than positive feedback, and in some studies positive feedback elicits a positive-going deflection in the FRN time-range, the feedback-positivity (FP) (Holroyd et al., 2008). Evidence suggests the FRN/FP is generated by prefrontal cortical regions associated with performance monitoring, and reflects the processing of dopaminergic reinforcement learning signals triggered by feedback indicating behaviour was better or worse than expected (Bellebaum and Daum, 2008, Luque et al., 2012, Oliveira et al., 2007). FRN/FP amplitudes decrease during a reinforcement learning episode, likely reflecting decreased reliance on external feedback with increasing knowledge of the to-be-learned behaviours (Eppinger et al., 2009, Holroyd and Coles, 2002).

Children show less enhancement of the FRN for negative compared with positive feedback, suggesting children are poorer at differentiating between types of feedback than adults (Hämmerer et al., 2010). The authors suggest this may explain why learning is more disrupted in children when feedback is probabilistic and difficult to discriminate. FP amplitude decreases less across learning in children than adults and ERP correlates of monitoring errors in performance differentiate less between correct and error responses in children than in adults (Eppinger et al., 2009). Based on these differences between children and adults, Eppinger et al. (2009) suggested that children have weaker internal representations of whether a response is correct or erroneous, resulting in a greater reliance on feedback processing to achieve successful performance. In a recent review of this literature, Hämmerer and

Eppinger (2012) proposed that increasing reinforcement learning ability reflects developing efficiency in processing feedback, using reinforcements effectively to guide goal-directed behaviour, and building internal representations of correct behaviours, as prefrontal cortical regions mature.

However, due to the scarcity of research in this area further studies are needed (Hämmerer and Eppinger, 2012). Furthermore, previous research has not addressed an important aspect of reinforcement learning, that is, the ability to alter and re-learn behaviours following changes in reinforcements. A robust finding in the executive function literature is that children are poorer than adults in switching to new behaviours when prompted by cues (Koolschijn et al., 2011). This suggests that children will have particular difficulty with learning when reinforcement contingencies change. Furthermore, the learning tasks used previously have been complicated, with multiple feedback conditions presented for different S–R associations within task blocks, creating considerable working memory demands (Crone et al., 2004, Eppinger et al., 2009, Hämmerer et al., 2010). Crone et al. (2004) and Eppinger et al. (2009) controlled for this problem by allocating children extra response time, but nevertheless the difficulty of these tasks may have enhanced developmental differences.

1.3. The current study

The study aims were firstly to further investigate neurocognitive differences in the typical development of reinforcement learning using a simple task designed to reduce the influence of age-related performance differences on ERP correlates of learning. The intention was to ensure all participants could perform the task

adequately regardless of age so that any ERP differences are more likely to reflect differences in the recruitment of neural networks underlying task performance, rather than floor or ceiling effects in one age group. Secondly, to assess developmental differences in the ability to change and re-learn acquired behaviour in response to altered reinforcement contingencies we compared children aged 9–11 years with adults aged 21 years and over. Our aim was to establish whether children differ from adults in behavioural and brain correlates of learning before they undergo the significant maturational changes that take place during adolescence. During EEG recording typically developing children and adults performed a task in which they learned four S–R associations by positive and negative feedback and then reversed the associations after an unexpected change in reinforcement contingencies. Changes in performance and feedback processing, indexed by the FRN, related to learning and reversal were examined across the task and between age groups. Additionally, changes in the P3 ERP, a positive deflection at ~300 ms post-stimulus, were examined. P3 amplitude increases with progressing reinforcement learning in adults, which is thought to reflect increasing consolidation of to-be-learned behaviours). The P3 may further elucidate neurocognitive differences between children and adults, for example, children may show weaker consolidation of associations than adults reflected by smaller P3 amplitude increases with learning. We predicted children would show smaller learning-related changes in performance and ERP amplitudes during the initial acquisition of S–R mappings than adults, reflecting poorer learning ability at this age. Further, we expected children to show greater disruptions to performance and greater reliance on

feedback, indexed by smaller FRN amplitude changes, when the reversal occurred.

2. Method

2.1. Participants

Fourteen 9–11 year olds (12 male, mean age: 10.2 years) and 15 adults (5 male, mean age: 25.5 years) were recruited from local primary schools and the University of Nottingham, UK to take part in this study. Participants were typically developing with no known neurological or psychiatric problems which may have affected brain function, right-handed (determined by the dominant hand for writing) and had normal or corrected-to-normal vision. Participants were tested in accordance with procedures approved by the University of Nottingham Medical School Ethics Committee and/or the East Midlands NHS Research Ethics Committee. Monetary reimbursement (£10) was provided for taking part.

2.2. Reinforcement learning task and testing procedure

The reinforcement learning task required participants to learn by trial-and-error, using deterministic (always valid) performance feedback, to associate a set of two visual stimuli with a right hand button-press and another two stimuli with a left hand button-press. Three blocks of trials were presented for participants to learn the stimulus–response (S–R) associations. The S–R mappings reversed unexpectedly in a fourth block, requiring participants to re-learn the correct response for each stimulus. In a fifth block, the mappings remained reversed. Every block contained 48 trials, with each stimulus presented 12 times in random order in each block. Particular S–R associations were counterbalanced across

participants. Stimuli were four cartoon characters from a popular animated film, presented in colour and surrounded by a rectangular 3 mm thick green frame. Stimuli measured 60 mm × 57 mm including the frame. Circular yellow happy-face images and blue sad-face images (both 60 mm in diameter) were used as positive and negative feedback. The words 'Too slow!' (10 mm × 90 mm) were displayed in green for late responses.

Acquisition of simple new behaviours by reinforcement

Children and adults showed equivalent increases in accuracy and P3 amplitude and decreases in FRN amplitude as they learned the S–R associations. Therefore, in contrast to previous research children in this study acquired and consolidated new behaviours and gradually decreased their use of external feedback at the same rate as adults. Accuracy significantly correlated with FRN amplitude during the first task block in children, indicating that feedback processing was related to the correct production of S–R associations in children in this study. This extends previous research by indicating that feedback processing and guidance of goal-directed behaviour by reinforcement information is not deficient in children compared with adults, as has previously been proposed .

Our findings indicate that when reinforcement learning is non-probabilistic the neural mechanisms underlying this basic form of learning work as efficiently in children as in adults. Problems with acquiring new behaviours may only appear in children when reinforcement learning becomes more complicated, for instance when reinforcements are unclear, for example probabilistic, and demands on other maturing cognitive functions such as working memory or executive function are high. As such, our findings

highlight the importance of ensuring task difficulty is appropriate for children in developmental investigations of reinforcement learning.

4.2. Developmental differences in altering learned behaviours by reinforcement

Performance was significantly more impaired in children than adults when reinforcements changed and the reversal of S–R associations was required in block 4 of the task. Nevertheless, following the reversal children improved their performance at the same rate as adults (task block 5). These findings suggest that children have specific performance difficulties when unexpected changes in reinforcements occur, but are eventually able to re-acquire simple behaviours in a similar manner to adults. Analysis of the P3 and FRN revealed further developmental differences in neurocognitive processes underlying performance.

The magnitude of P3 amplitude changes during learning can be considered to index the strength of internal representation of correct S–R associations in working memory (Barceló et al., 2000, Rose et al., 2001). P3 amplitude changes were significantly greater in adults than children, decreasing more during reversal of associations and increasing more with re-acquisition of reversed mappings, indicating that internal representations of the S–R associations underwent less adaptation and re-consolidation in children than adults. In contrast, FRN amplitude changes were greatest in children, decreasing more with re-learning of the associations in block 5 than in adults. Indeed, FRN amplitude showed little variation after the first task block in adults while a prominent increase with reversal and decrease with re-acquisition was observed in children, indicating that feedback processing varied more with reversal and re-learning in children

than adults. Previous authors have emphasised that difficulties with feedback processing, resulting from immature performance monitoring functions of the developing prefrontal cortex, underlie children's poorer reinforcement learning performance (Hämmerer and Eppinger, 2012, Hämmerer et al., 2010). It has been suggested that children are less successful than adults in integrating feedback information with motor action plans, or that children use feedback in a less goal-directed manner than adults (Hämmerer and Eppinger, 2012, Hämmerer et al., 2010). In contrast to the latter proposal, our findings suggest that children do use feedback to drive goal-directed learning behaviour. Changes in FRN amplitude were associated with changes in performance accuracy in children when most re-learning was occurring (block 4). Furthermore, FRN changes were largest in children, indicating children were using feedback more than adults to guide behaviour. However, as children performed more poorly than adults, children may have had greater difficulty in integrating feedback information to consolidate S–R associations and so produce the correct behaviours, consistent with other work using a probabilistic learning task (Van Duijvenvoorde et al., 2013).

Errors were not sufficiently numerous to allow analysis of the ERN in this study. However, the profile of P3 and FRN effects here are similar to the ERN and FP findings reported by Eppinger et al. (2009), and support the proposal put forward by those authors that children build weaker internal representations of to-be-learned behaviours and engage in greater processing of external feedback than adults when alterations in reinforcement learning are required. This may be due to interference arising from the extra cognitive processing demands of reversing the S–R associations, such as the requirement to suppress the previously correct behaviours and

produce new responses that conflict with the original S–R associations. A wealth of evidence demonstrates that such executive functions are poorer in children than adults (Johnstone et al., 2005, Ladouceur et al., 2007, Rueda et al., 2004). Therefore, it may be that these additional processing requirements reduce children's cognitive capacity for learning, decreasing the efficiency of the processes of consolidating the reversed S–R associations and integrating new feedback information with behaviour plans. Children may exercise greater feedback processing to compensate for these difficulties. Alternatively, the enhanced FRN in children may reflect a greater affective or motivational response to correct responses during the more challenging phases of the task. Amplitude of the FRN to negative feedback has been related to individual differences in punishment sensitivity in adolescence and adults (Santesso et al., 2011) and may reflect evaluation of good versus bad outcomes based on motivational as well as cognitive goals (Hajcak et al., 2006). It is possible therefore that the children in the present study invoked this evaluative process more strongly than adults having encountered greater difficulty during the reversal phase of the task. However, the present task was not designed with this question in mind and further research is needed to investigate the role of the FRN in children in this age range.

Another possible explanation for our findings is that children learn in a different manner from adults. Research in adults has shown that providing information about reward likelihood enhances the reinforcement learning process. For example, Li et al. (2011) and Walsh and Anderson (2011) compared adults' performance on a probabilistic S–R learning task when no information about reinforcement probabilities was given and adults

were required to learn the S–R associations solely by feedback, with a separate condition in which participants were instructed as to the probability that each S–R pair would be followed by valid feedback, for example that one S–R association would be correctly reinforced on 30% of trials. Adults' performance increased gradually in the no-instruction learning condition, but began and remained at asymptote in the instruction condition. The enhancing effect of instruction on learning is suggested to reflect the top-down influence of rules for learning represented in prefrontal regions on striatal reinforcement learning mechanisms (Li et al., 2011).

In the current study, a rule for how the S–R associations should be re-learned would have been acquired easily after only a few trials in block 4 based on knowledge of what the original S–R mappings were and identifying that the mappings simply had to be reversed. If implemented, this rule would facilitate faster re-learning of the associations. Adults verbally reported that they realised the S–R combinations in block 4 were simply the opposite of those in blocks 1–3. Adults' rapid increase in consolidation of the new S–R associations, improvement in performance and minimal variation of the FRN suggests that they used this inferred rule to guide re-learning rather than relied on external feedback. Children's slower consolidation of reversed S–R associations, more disrupted performance, and greater feedback processing suggests that they were relying on external reinforcement information rather than the internally derived rule for re-learning that adults appeared to employ. Therefore, a possible explanation for the developmental difference in performance and neurocognitive processing in the reversal phase is that unlike adults, children do not infer and use rules for learning, and instead rely on slower feedback-based

learning. It is unclear whether this reflects an inability of children to infer learning rules and use them to drive performance due to under-developed prefrontal regions, or a strategic preference for experience-based learning in children. Future studies comparing instruction-based and experience-based learning in children and adults would be useful in clarifying this issue.

One final observation to discuss is the prolonged negativity following the FRN observed in the feedback-locked waveforms in all learning blocks in children but not in adults . A detailed analysis of this component was beyond the scope of this article, but would be worthy of future research. It is likely that this second negative peak in the children reflects a second oscillation of the same on-going physiological process (feedback-processing), and may occur due to additional or more effortful processing of the feedback information in children to compensate for their greater difficulty in learning the S–R associations. Alternatively, this negativity might index different learning strategies used in children compared with adults. A recent study comparing feedback-locked potentials between groups of adults using different learning strategies to acquire new behaviours reported strategy-related differences in the morphology of positive feedback components.

Behaviour modification and its applications of Reinforcement:

- **Agent:** It is an assumed entity which performs actions in an environment to gain some reward.
- **Environment (e):** A scenario that an agent has to face.

- **Reward (R):** An immediate return given to an agent when he or she performs specific action or task.
- **State (s):** State refers to the current situation returned by the environment.
- **Policy (π):** It is a strategy which applies by the agent to decide the next action based on the current state.
- **Value (V):** It is expected long-term return with discount, as compared to the short-term reward.
- **Value Function:** It specifies the value of a state that is the total amount of reward. It is an agent which should be expected beginning from that state.
- **Model of the environment:** This mimics the behavior of the environment. It helps you to make inferences to be made and also determine how the environment will behave.
- **Model based methods:** It is a method for solving reinforcement learning problems which use model-based methods.
- **Q value or action value (Q):** Q value is quite similar to value. The only difference between the two is that it takes an additional parameter as a current action.

Reinforcement Learning works

Let's see some simple example which helps you to illustrate the reinforcement learning mechanism.

Consider the scenario of teaching new tricks to your cat

- As cat doesn't understand English or any other human language, we can't tell her directly what to do. Instead, we follow a different strategy.
- We emulate a situation, and the cat tries to respond in many different ways. If the cat's response is the desired way, we will give her fish.
- Now whenever the cat is exposed to the same situation, the cat executes a similar action with even more enthusiastically in expectation of getting more reward(food).
- That's like learning that cat gets from "what to do" from positive experiences.
- At the same time, the cat also learns what not do when faced with negative experiences.

Model-Based:

In this Reinforcement Learning method, you need to create a virtual model for each environment. The agent learns to perform in that specific environment.

Characteristics of Reinforcement Learning

Here are important characteristics of reinforcement learning

- There is no supervisor, only a real number or reward signal
- Sequential decision making
- Time plays a crucial role in Reinforcement problems

- Feedback is always delayed, not instantaneous
- Agent's actions determine the subsequent data it receives

Types of Reinforcement Learning

Two kinds of reinforcement learning methods are:

Positive:

It is defined as an event, that occurs because of specific behavior. It increases the strength and the frequency of the behavior and impacts positively on the action taken by the agent.

This type of Reinforcement helps you to maximize performance and sustain change for a more extended period. However, too much Reinforcement may lead to over-optimization of state, which can affect the results.

Negative:

Negative Reinforcement is defined as strengthening of behavior that occurs because of a negative condition which should have stopped or avoided. It helps you to define the minimum stand of performance. However, the drawback of this method is that it provides enough to meet up the minimum behavior.

Learning Models of Reinforcement

There are two important learning models in reinforcement learning:

- Markov Decision Process
- Q learning

Markov Decision Process

The following parameters are used to get a solution:

- Set of actions- A
- Set of states -S
- Reward- R
- Policy- n
- Value- V

The mathematical approach for mapping a solution in reinforcement Learning is recon as a Markov Decision Process or (MDP).

Reinforcement Learning vs. Supervised Learning

Parameters	**Reinforcement Learning**
Decision style	reinforcement learning helps you to take your decisions sequentially.
Works on	Works on interacting with the environment.
Dependency on decision	In RL method learning decision is dependent. Therefore, you should give labels to all the dependent decisions.

Best suited	Supports and work better in AI, where human interaction is prevalent.
Example	Chess game

Applications of Reinforcement Learning

Here are applications of Reinforcement Learning:

- Robotics for industrial automation.
- Business strategy planning
- Machine learning and data processing
- It helps you to create training systems that provide custom instruction and materials according to the requirement of students.
- Aircraft control and robot motion control

Why use Reinforcement Learning?

Here are prime reasons for using Reinforcement Learning:

- It helps you to find which situation needs an action
- Helps you to discover which action yields the highest reward over the longer period.
- Reinforcement Learning also provides the learning agent with a reward function.

- It also allows it to figure out the best method for obtaining large rewards.

When Not to Use Reinforcement Learning?

You can't apply reinforcement learning model is all the situation. Here are some conditions when you should not use reinforcement learning model.

- When you have enough data to solve the problem with a supervised learning method
- You need to remember that Reinforcement Learning is computing-heavy and time-consuming. in particular when the action space is large.

Challenges of Reinforcement Learning

Here are the major challenges you will face while doing Reinforcement earning:

- Feature/reward design which should be very involved
- Parameters may affect the speed of learning.
- Realistic environments can have partial observability.
- Too much Reinforcement may lead to an overload of states which can diminish the results.
- Realistic environments can be non-stationary.

Summary:

- Reinforcement Learning is a Machine Learning method

- Helps you to discover which action yields the highest reward over the longer period.
- Three methods for reinforcement learning are 1) Value-based 2) Policy-based and Model based learning.
- Agent, State, Reward, Environment, Value function Model of the environment, Model based methods, are some important terms using in RL learning method
- The example of reinforcement learning is your cat is an agent that is exposed to the environment.
- The biggest characteristic of this method is that there is no supervisor, only a real number or reward signal
- Two types of reinforcement learning are 1) Positive 2) Negative
- Two widely used learning model are 1) Markov Decision Process 2) Q learning
- Reinforcement Learning method works on interacting with the environment, whereas the supervised learning method works on given sample data or example.
- Application or reinforcement learning methods are: Robotics for industrial automation and business strategy planning
- You should not use this method when you have enough data to solve the problem
- The biggest challenge of this method is that parameters may affect the speed of learning

Cognitive approaches in learning: Latent learning, observational learning

Cognitive approaches to learning are concerned with how information is processed by learners.

Cognitive theories view students as active in “an internal learning process that involves memory, thinking, reflection, abstraction, motivation, and meta-cognition” (Ally, 2008). Students organize old knowledge, scripts, and schema, find relationships, and link new information to old (Cognitive Theories of Learning, n.d.). Ertmer and Newby (1993) note that “learning is a change in the state of knowledge, and is a mental activity where an active learner internally codes and structures knowledge” (p. 58). They believe that “the real focus of the cognitive approach is on changing the learner by encouraging him/her to use appropriate learning strategies” (Ertmer & Newby, 1993, p. 59).

Cognition refers to mental activity including thinking, remembering, learning and using language. When we apply a cognitive approach to learning and teaching, we focus on theunderstaning of information and concepts. If we are able to understand theconnections between concepts, break down information and rebuild with logicalconnections, then our rention of material and understanding will increase.

When we are aware of these mental actions, monitor them and control ourlearning processes it is called metacognition

Classifying Cognitivist Theories

Behaviorist, cognitivist, and constructivist ideas and principles overlap in many areas (Ally, 2008). Therefore, classifying theories is challenging; some theories fit in more than one classification and different sources classify the theories in different ways. For example, in some sources Jerome Bruner's Discovery Learning Theory is classified as cognitive (Using the Web for Learning: Background, n.d.) and not developmental (Cognitive Theories of Learning, n.d.). In other sources, Bruner is deemed developmental (Driscoll, 2005/2007). In still other sources, Bruner is considered constructivist (Learning Theories Knowledgebase, 2009). In addition, Albert Bandura is often classified as a behaviorist; however, Bandura, himself, claimed that he was never a behaviorist (From Behaviorism to Social Cognition??, n.d.).

Classifications

Course materials in ETEC 512 classified theorists as follows:

Cognitive

- Social Cognitive Theory (Social Learning Theory) by Bandura
    - Bandura focused on observational learning and self-efficacy (Zeldin, Britner, & Pajares, 2008).
- Information Processing Theories by various theorists
    - The computer was seen as a metaphor for the mind (Schunk 2004/2007a).
    - Information was input and the mind processed the information, creating output (Information Processing, n.d.).

- Assimilation Theory (Meaningful Learning) by Ausubel
    - Ausubel focused on reception learning; he noted that the learner was active and thus he differentiated between rote and meaningful learning (Novak, 1998/2007).
    - Ausubel stressed the importance of the advance organizer.

Developmental

- Genetic Epistemology by Piaget
    - Piaget believed that experience with the environment affected knowledge acquisition.
    - His four stages of development detail how humans develop cognitively.
- Sociocultural Theory by Vygotsky
    - Vygotsky's Zone of Proximal Development (ZPD) details the difference between what a learner can do independently and what the leaner can do with help; independent learning may not take place, but scaffolded learning can.
- Discovery Learning by Bruner
    - Bruner describes representational stages, and emphasizes exploring the environment.

Concept Map of Cognitive and Developmental Theories

Using the computer metaphor of input and output, this concept map of the theories organizes the main principles. The component referring to an individual is shown on the left hand side of each theory diagram, while the social contribution is shown on the right hand side.

Components of Cognitive Learning Approaches

Ertmer and Newby (1993) describe the commonalities that exist between the many different cognitive theories:

How Learning Occurs

- mental activity: internal coding and structuring by the learner
- change occurs in state of knowledge

Factors Influencing Learning

- environmental conditions
- practice with corrective feedback
- processes of mental planning, goal-setting, and organizational strategies
- way learners attend to, code, transform, rehearse, store and retrieve information
- learners' thoughts, beliefs, attitudes, and values

Role of Memory

- information is stored in an organized, meaningful manner; need to relate new information to prior knowledge

Transfer

- function of how information is stored in memory
- occurs when learner understands how to apply knowledge in different contexts

Types of Learning Best Explained

- complex forms of learning (reasoning, problem-solving, information-processing)
- communicate/transfer knowledge in an efficient effective manner: simplification, standardization (knowledge analyzed, decomposed, simplified into basic building blocks; irrelevant information eliminated)

Instructional Design

- feedback to help create accurate mental representations and connections
- learner and task analysis: determine learner's predisposition to learning; look at existing mental structures to design instruction so it can be readily assimilated

Major Tasks of Teacher/Designer

- understand that learners have different backgrounds/experiences which can impact learning outcomes
- determine the most effective manner in which to organize and structure new information to work with these backgrounds/experiences

- arrange practice with feedback so that the new information is effectively and efficiently assimilated and /or accommodated with the learner's cognitive structure

Relevance of Cognitivist Approaches

Cognitivist approaches to learning are relevant to today's educators. Pratt (n.d.) cautions "while I do not argue with the basic tenets of constructivism, I do resist the rush to adopt any single, dominant view of learning or teaching" (p. 1). Hung (2001) advises that "instead of regarding the different learning theories as discordant, we rather adopt the instructional approaches derived from each of the learning theories and situate them in the appropriate instructional context based on the learning objectives" (Conclusion). Ertmer and Newby (1993) suggest that the best theoretical approach depends on the learner's experience with the knowledge, and the level of cognitive processing required by the task; behaviourist approaches can allow the learner to master content (know what), cognitivist approaches are better for problem-solving with facts and rules applied in unfamiliar situations (know how), and constructivist approaches are better for ill-defined problems (reflection-in-action).

Distributed Learning

In a Distributed Learning (DL) program, parents are very involved in helping their children learn. The parents are not trained teachers, and have difficulty with using pedagogy to inform their practices at home. The parents find value in the efficient delivery method inherent in cognitivist approaches. DL students in programs that have social/interactive components (face-to-face classes or online discussions) can use the knowledge and skills learned from a

cognitivist approach, from content to critical thinking and problem-solving strategies, to engage in knowledge construction. Pratt (n.d.) states "that teachers are 'pedagogical engineers' with the responsibility to plan a lesson(s) with the most relevant instructional approaches and technologies at his or her disposal" (Conclusion). In a DL program, it is the teacher's responsibility to understand the needs of parents and learners; this makes it even more important that teachers understand and choose the most relevant approach.

Latent Learning

Strict behaviorists like Watson and Skinner focused exclusively on studying behavior rather than cognition (such as thoughts and expectations). In fact, Skinner was such a staunch believer that cognition didn't matter that his ideas were considered **radical**

behaviorism. Skinner considered the mind a "black box"—something completely unknowable—and, therefore, something not to be studied. However, another behaviorist, Edward C. Tolman, had a different opinion. Tolman's experiments with rats demonstrated that organisms can learn even if they do not receive immediate reinforcement (Tolman & Honzik, 1930; Tolman, Ritchie, & Kalish, 1946). This finding was in conflict with the prevailing idea at the time that reinforcement must be immediate in order for learning to occur, thus suggesting a cognitive aspect to learning.

Latent learning is a form of learning that is not immediately expressed in an overt response. It occurs without any obvious reinforcement of the behavior or associations that are learned.

Latent learning is not readily apparent to the researcher because it is not shown behaviorally until there is sufficient motivation. This type of learning broke the constraints of behaviorism, which stated that processes must be directly observable and that learning was the direct consequence of conditioning to stimuli.

In the experiments, Tolman placed hungry rats in a maze with no reward for finding their way through it. He also studied a comparison group that was rewarded with food at the end of the maze. As the unreinforced rats explored the maze, they developed a **cognitive map**: a mental picture of the layout of the maze (Figure 1).

After 10 sessions in the maze without reinforcement, food was placed in a goal box at the end of the maze. As soon as the rats became aware of the food, they were able to find their way through the maze quickly, just as quickly as the comparison group, which had been rewarded with food all along. This is known as latent learning: learning that occurs but is not observable in behavior until there is a reason to demonstrate it.

Latent learning also occurs in humans. Children may learn by watching the actions of their parents but only demonstrate it at a later date, when the learned material is needed. For example, suppose that Ravi's dad drives him to school every day. In this way, Ravi learns the route from his house to his school, but he's never driven there himself, so he has not had a chance to demonstrate that he's learned the way. One morning Ravi's dad has to leave early for a meeting, so he can't drive Ravi to school. Instead, Ravi follows the same route on his bike that his dad would have taken in the car. This demonstrates latent learning. Ravi had learned the

route to school, but had no need to demonstrate this knowledge earlier.

EVERYDAY CONNECTION: THIS PLACE IS LIKE A MAZE

Have you ever gotten lost in a building and couldn't find your way back out? While that can be frustrating, you're not alone. At one time or another we've all gotten lost in places like a museum, hospital, or university library. Whenever we go someplace new, we build a mental representation—or cognitive map—of the location, as Tolman's rats built a cognitive map of their maze. However, some buildings are confusing because they include many areas that look alike or have short lines of sight. Because of this, it's often difficult to predict what's around a corner or decide whether to turn left or right to get out of a building.

Psychologist Laura Carlson (2010) suggests that what we place in our cognitive map can impact our success in navigating through the environment. She suggests that paying attention to specific features upon entering a building, such as a picture on the wall, a fountain, a statue, or an escalator, adds information to our cognitive map that can be used later to help find our way out of the building.

Observational learning

Observational learning, method of learning that consists of observing and modeling another individual's behavior, attitudes, or emotional expressions. Although it is commonly believed that the observer will copy the model, American psychologist Albert Bandura stressed that individuals may simply learn from the behavior rather than imitate it. Observational learning is a major

component of Bandura's social learning theory. He also emphasized that four conditions were necessary in any form of observing and modeling behavior: attention, retention, reproduction, and motivation.

Conditions For Observational Learning

Attention

If an organism is going to learn anything from a model, he or she must be paying attention to it and the behavior it exhibits. Many conditions can affect the observer's attention. For instance, if the observer is sleepy, ill, or distracted, he or she will be less likely to learn the modeled behavior and imitate it at a later date. In addition, the characteristics of the model have an influence on the observer's attention. Bandura and others have shown that humans pay more attention to models that are attractive, similar to them, or prestigious and are rewarded for their behaviors. This explains the appeal that athletes have on the behavior of young children and that successful adults have on college students. Unfortunately, this aspect of modeling can also be used in detrimental ways. For example, if young children witness gang members gaining status or money, they may imitate those behaviors in an effort to gain similar rewards.

Retention

The second requirement of observational learning is being able to remember the behavior that was witnessed. If the human or animal does not remember the behavior, there is a less than probable chance that they will imitate it.

Reproduction

This requisite of behavior concerns the physical and mental ability of the individual to copy the behavior he or she observed. For instance, a young child may observe a college basketball player dunk a ball. Later, when the child has a basketball, he or she may attempt to dunk a ball just like the college player. However, the young child is not nearly as physically developed as the older college player and, no matter how many times he or she tries, will not be able to reach the basket to dunk the ball.

An older child or an adult might be able to dunk the ball but likely only after quite a bit of practice. Similarly, a young colt observes another horse in the herd jump over the creek while running in the pasture. After observing the model's jumping behavior, the colt attempts to do the same only to land in the middle of the creek. He simply was not big enough or did not have long enough legs to clear the water. He could, however, after physical growth and some practice, eventually be able to replicate the other horse's jump.

Motivation

Perhaps the most important aspect of observational learning involves motivation. If the human or animal does not have a reason for imitating the behavior, then no amount of attention, retention, or reproduction will overcome the lack of motivation. Bandura identified several motivating factors for imitation. These include knowing that the model was previously reinforced for the behavior, being offered an incentive to perform, or observing the model receiving reinforcement for the behavior. These factors can also be negative motivations. For instance, if the observer knew that the model was punished for the behavior, was threatened for exhibiting the

behavior, or observed the model being punished for the behavior, then the probability of mimicking the behavior is less.

Applications Of Observational Learning

Modeling has been used successfully in many therapeutic conditions. Many therapists have used forms of modeling to assist their patients to overcome phobias. For example, adults with claustrophobia may observe a model in a video as they move closer and closer to an enclosed area before entering it. Once the model reaches the enclosed area, for instance a closet, he or she will open the door, enter it, and then close the door. The observer will be taught relaxation techniques and be told to practice them anytime he or she becomes anxious while watching the film. The end result is to continue observing the model until the person can enter the closet himself or herself.

Bandura's findings in the Bobo doll experiments have greatly influenced children's television programming. Bandura filmed his students physically attacking the Bobo doll, an inflatable doll with a rounded bottom that pops back up when knocked down. A student was placed in the room with the Bobo doll. The student punched the doll, yelled "sockeroo" at it, kicked it, hit it with hammers, and sat on it. Bandura then showed this film to young children. Their behavior was taped when in the room with the doll. The children imitated the behaviors of the student and at times even became more aggressive toward the doll than what they had observed. Another group of young children observed a student being nice to the doll. Ironically, this group of children did not imitate the positive interaction of the model. Bandura conducted a large number of varied scenarios of this study and found similar events even when

the doll was a live clown. These findings have prompted many parents to monitor the television shows their children watch and the friends or peers with which they associate. Unfortunately, the parental saying “Do as I say, not as I do” does not hold true for children. Children are more likely to imitate the behaviors versus the instructions of their parents.

One of the most famous instances of observational learning in animals involves the blue , a small European bird. During the 1920s and through the 1940s, many people reported that the cream from the top of the milk being delivered to their homes was being stolen. The cream-stealing incidents spread all over Great Britain. After much speculation about the missing cream, it was discovered that the blue tit was the culprit. Specifically, one bird had learned to peck through the foil top of the milk container and suck the cream out of the bottle. It did not take long before other blue tit birds imitated the behavior and spread it through the country.

Verbal Learning

Verbal learning is the process of acquiring, retaining and recalling of verbal material. At its most elementary level, it can be defined as a process of building associations between a stimulus and a response, with both of them being verbal. At a broader level, verbal learning includes the processes of organizing the stimulus material by the learner and the related changes in the learner's behavior.

At different stages of the development of the verbal learning studies, a variety of aspects of this phenomenon were highlighted. For example, German psychologist Hermann Ebbinghaus (1850-1909)

in his book On Memory (1885), focused on the processes of association building and recall, which shaped his experiments with verbal material. Ebbinghaus's work, albeit not dealing explicitly with verbal learning, is considered as the first seminal work in the field, due to the material and the methods used.

Verbal learning can be based on different processes and can be classified in several types. The first process is serial verbal learning. People engage in it when they learn a list of verbal items (for example, words or syllables) while maintaining the order of the items. Psychologists test this type of learning by asking subjects to read a list of verbal stimuli and then reproduce this list while keeping the original order of the items. Such experiments have been widely used in tests of short- and long-term memory.

A useful strategy that can be used while remembering such lists of words is to build associations between them. Thus, the first word "anticipates" the second, and, analogically, every word points to the one after it. Ebbinghaus called this learning strategy the serial anticipation method. Studies of this type of learning have also discovered the serial position effect, which says that different parts of the list are learned with different difficulty. Usually, the first few items are the easiest to learn, then come those at the end of the list. The hardest to learn are the items just after the middle.

Another type of verbal learning is referred to paired associate learning. It happens when people read pairs of words, or other verbal stimuli, then get to see just one item of a pair and have to say what the other is. This type of learning is largely used in education, especially in learning foreign languages. Pupils learn vocabularies as pairs of known English words and words from another language,

building associations between the items of a pair. Then, when presented with a foreign word (stimulus), the pupil has to name the corresponding English word (response).

Free verbal learning is a type of learning, which people use when they learn lists of items regardless of their order. A task used to test this type of learning is free recall. The subject is asked to recall as many items from a list as possible, regardless of their sequence. Such tests are often used to establish organizational patterns of learning and memory. For example, the subject may use a clustering strategy - grouping items according to their similarity or the number of letters in them.

Another kind of verbal learning is verbal discrimination (or recognition) learning. It is studied by a task which requires of the subject, after reading a list of items, to read another one and to say which items of the second list were present in the first. Verbal learning theorists use different materials in their tests. Ebbinghaus used nonsense syllables - syllables of the type consonant-vowel-consonant, such as GOC, TER, and BIV. He argued that these stimuli were easily controlled and thus had an advantage for being used in the studies of memory compared to meaningful words.

In 1932, British psychologist Frederic Bartlett (1886-1969) challenged Ebbinghaus's view that nonsense syllables were easily controlled and that they eliminated meaning as a factor in learning. Another influential perspective and perhaps the most important contribution to this field was The Psychology of Human Learning: An Introduction (1942) by John McGeoch (1897-1942), a book which summarized many of the trends in verbal learning.

In the 1950s, the verbal learning studies focused on verbal behavior - the characteristics of language and its use. In the 1960s through to the 1980s, psycholinguists developed models of word acquisition, verbal information processing and lexicon building. Examples of such models are the logogen model of John Morton (1969), which was considered to be an important theory, along with the PDP (parallel distributed processing) model of Mark Seidenberg and James Lloyd McClelland (1989).

Discrimination learning

Learning Set and Learning by Exclusion

Discrimination learning can be generalized. The point is illustrated by experiments with monkeys on learning set. In the typical procedure, a monkey is presented with two objects; under one is a piece of food. When it learns the discrimination, two new objects are presented, and so on. Learning proceeds more rapidly after each problem until it learns new discriminations in a single trial. Learning set has also been demonstrated in other species and with other tasks.

Learning set is evident in a word-learning discrimination called learning by exclusion. In typical experiments employing nonverbal humans with mental retardation, subjects are first taught names for several foods. Then a new food is placed among foods with known names. Without any further training or prompts, subjects are asked to point to the new food that is given a never before heard name. Experienced subjects correctly select the novel food on the first test, and in subsequent tests with that food and new foods they

demonstrate retention of the new name. These experiments show that after learning several names, individuals learn the contingency that exists between new names and new objects.

Discrimination Learning

Discrimination learning can be used as a part of training for more difficult tasks, including the judgement bias tasks and Iowa gambling task described earlier in the chapter. It can, however, also be used as a task in and of itself, to determine the ability of animals to discriminate between two stimuli and the capacity of animals to learn and perform tasks based on discrimination in different modalities.

Visual discrimination is frequently used in discrimination learning in various species. This can entail the use of lights, including discrimination between light color, intensity, or frequency of flashing lights. Visual stimuli can also include the use of pictures or patterns. Pigs have visual acuity which is inferior to humans, sheep, and cattle (Entsu et al., 1992; Tanaka et al., 1995; Zonderland et al., 2008) but which should, in theory, be quite sufficient for learning visual discriminations. In practice, however, discrimination based on visual stimuli in pigs has proven quite difficult, requiring lengthy training to show operant responses to distinct 2D shapes (Gieling et al., 2012a; Graf, 1976; Haagensen et al., 2013). Discrimination of conspecifics based on photographs, which has been demonstrated in domestic sheep (Ferreira et al., 2004) and cows (Coulon et al., 2009) did not seem to be possible in pigs (Gieling et al., 2012a).

Discrimination tasks based on auditory stimuli have been more successful, with pigs showing distinct operant responses to auditory

stimuli of different frequencies (Murphy et al., 2013a). Other modalities, such as odor cues or tactile cues, have yet to be tested in pigs. Given their strong olfactory and tactile abilities (the snout is particularly sensitive), this may be an interesting avenue to explore to improve discrimination learning.

Neural Basis

The different forms of discrimination learning and reversal tasks seem to have distinct neural bases. Rapid acquisition of object discrimination problems seems to involve the inferotemporal cortex and ventral prefrontal cortex, as well as the mediodorsal thalamus (Gaffan and Murray, 1990; Gaffan et al., 1993; Baxter and Murray, 2000). The entorhinal and perirhinal cortices seem to be required for rapid learning of visual discrimination problems only to the extent that these cortical areas are involved in identification of the stimuli to be discriminated (see discussion in Baxter et al., 1999). Other medial temporal lobe structures may be involved in retention of these rapidly learned discrimination problems (Zola-Morgan et al., 1994; Alvarez et al., 1995). In contrast, slow learning of object discrimination problems (e.g., in the “24-hr ITI” task) is independent of limbic structures (amygdala and hippocampus) but does require inferior temporal cortical area TE (Phillips et al., 1988) and again the entorhinal and perirhinal cortices only to the extent that object identification is taxed (Buckley and Gaffan, 1997; Thornton et al., 1998); as well as the ventral and orbital frontal cortices (Murray and Wise, 1997) and the tail of the caudate nucleus (Wang et al., 1990). The commonality between cortical systems required for learning of visual discrimination problems and visual recognition memory is notable (see Section II,B). Interestingly, individual

monkeys who are impaired on DNMS performance also appear to demonstrate an impairment in object discrimination learning (Rapp, 1993), suggesting a common neural substrate for these deficits, likely inferior temporal-prefrontal connections (see Section II,B).

Spatial discrimination learning appears to involve hippocampal formation and dorsolateral prefrontal cortex. Monkeys with dorsolateral prefrontal cortex lesions are markedly impaired on acquisition of a spatial discrimination problem (Pohl, 1973), as are monkeys with aspiration lesions of the hippocampus that include the overlying parahippocampal cortex (Jones and Mishkin, 1972). The contribution of the hippocampus proper to spatial discrimination learning is unclear, as monkeys with neurotoxic hippocampal lesions (sparing the parahippocampal cortex) are not impaired on this particular spatial discrimination learning task (Murray et al., 1998).

Reversal learning appears to recruit additional neural systems. Lesions that impair the initial discrimination also produce impairment in subsequent reversals of that discrimination. However, lesions of the orbitofrontal cortex, which produce no impairment in initial acquisition of a spatial discrimination, produce a marked impairment in reversal of that discrimination (Jones and Mishkin, 1972). Similarly, rhinal cortex lesions, which have little effect on object discriminations, produce an impairment in subsequent reversals of that discrimination (Murray et al., 1998).

Lesions restricted to the hippocampus also appear to produce an impairment in object reversals, milder than that produced by rhinal cortex lesions (Mahut, 1971; Murray et al., 1998). Of note is the pattern of errors made during reversal learning: Jones and Mishkin

(1972) analyzed errors in reversal learning based on whether the monkey was performing below chance (stage 1), at chance (stage 2), or above chance but not yet at criterion (stage 3).

Damage to the orbitofrontal cortex is characterized by a marked increase in stage 1 errors, suggestive of perseverative behavior (Jones and Mishkin, 1972). Rhinal cortex lesions produce similar perseverative behavior (Murray et al., 1998).

Hence, perseverative behavior on reversals may suggest damage to the prefrontal cortex, rhinal cortex, or both. It is also worth noting that impairments in reversal learning may be limited to the first time a particular type of reversal problem is encountered (Dias et al., 1997); this may explain why a lack of impairment on reversal learning is observed when the monkeys have previously performed reversals in a different stimulus domain (e.g., testing on spatial reversals after having performed object reversals).

Recent trends in learning: Neurophysiology of learning

Each new year brings with it new learning and development trends, and a few key themes are already shining through in 2019. Organisations are placing a strong emphasis on learning, while employees want more control of what, where and when they learn. They're also adopting both conventional and unconventional approaches to maximise their learning. This blog will uncover the latest trends in learning for 2019 including:

- Continuous learning culture
- Employee led learning

- People leaders as coaches
- Social learning
- Employee-curated content
- Mobile (aka on-demand)
- Microlearning
- Data and analytics
- Learning Experience Platform (LXP)
- Gamification, Augmented and Virtual Reality
- People data

The learning landscape is shifting. With continuous advances in technology, employees are taking control of their own education and development. Organisations are stepping up to help shape the future of learning. They're focusing on providing coaching, ongoing feedback and resources for learning opportunities.

Technologies which focus on usability and experience are helping improve learner engagement. Unsurprisingly, mobile and social learning are gaining traction and feature heavily in a modern learning environment. Learners are demanding just-in-time learning, where and when they want it.

Explore the shifts in learning with our updated learning trends for 2019.

1. Continuous learning culture

The shelf-life of skills is diminishing. The need for ongoing learning and development is greater than at any previous point in history. 38% of CEOs believe a shortage of key skills is the top people-related threat to growth. That's up from 31% in 2017. With this in mind, it's no surprise that building a culture of continuous learning is currently a priority for L&D leaders. This encompasses just-in-time learning designed to close a specific knowledge gap in a current role, right through to development of competencies and behaviours needed for future roles.

Today's learner expects (and is expected to) continually learn and develop. This culture of continual learning is simultaneously driving and being reinforced by the shifting attitude to performance management. As everyday performance and ongoing feedback approaches gain momentum, the desire to upskill, develop and close skill gaps reinforces the symbiotic relationship between performance and development.

2. Employee-led learning

Organisations are moving away from top-down driven development frameworks and empowering employees to lead their own learning. Some examples of employee-led learning include:

- moving away from a one-size-fits-all' approach
- creating personalised learning paths to help develop employees in their current role, next role and future roles;
- basing content on both development needs and interests.

68% of employees prefer to learn at work, according to recent research by LinkedIn, but they don't always have time to complete

learning activities. In fact, the same research found that the #1 challenge for talent development is getting employees to make time for learning.

As the above diagram suggests, over half of employees (58%) want to learn at their own pace depending on their requirements, development needs and interests. But employees still want their manager's input on how to improve, with 56% saying they would spend more time learning if their manager suggested activities.

Instead of a 'one-size-fits-all' approach, organisations are creating personalised learning paths that develop employees in their current role, next role and future career paths."

3. People leaders as coaches

Finding the time for learning is the number one development challenge employees face. The second-largest challenge is getting people leaders to take an active role in employee development. It's no longer only the responsibility of the L&D department to ensure employees get the training they need. Learning professionals are now looking to people managers to own and develop their teams. Empowering people leaders to help employees on their continuous learning journey is becoming a priority. When it's done well, it's highly successful. Nearly three-quarters (74%) of employees who felt empowered to drive their own career say that their manager provides coaching and supports their development.

4. Social learning

In addition to social collaborative tools, organisations are also experimenting with cross-functional project-based learning, creating

online learning marketplaces and structured mentoring forums. At the very minimum, employees expect workplace technologies that allow:

- social networking
- instant messaging,
- online collaboration;
- video conferencing.

Humans are social by nature: 87% of employees say that sharing knowledge with their team is critical for learning. 34% of organisations are already investing in social learning tools and over the next few years we anticipate the uptake will accelerate. The increasing complexity of work, rise of the contingent and freelance workforce, and the desire to work 'anywhere, anytime' will drive the adoption of social collaboration and knowledge-sharing tools.

5. Employee-curated content

Relevant content is what matters most to employees. Yet less than half (46%) of employees are satisfied with the relevance of the content provided by their organisation. How can we help employees cut through the clutter? Employees want the ability to create their own online content and share learning resources. It's no surprise that peer-to-peer learning continues to gain traction – empowering people to share relevant content with their colleagues.

Organisations are also supporting apps which curate, publish and share content to keep peers, teammates and managers across the latest and most relevant content. Crowdsourcing means content is

constantly refreshed, removing the barrier of irrelevant information which can deter time-poor learners.

6. Mobile (aka on-demand)

Employees expect to access content anytime, anywhere via a mobile device. Although this trend isn't new, corporate adoption levels have lagged behind employee expectations. Over three-quarters of employees do at least some of their learning on a mobile device and 99% of mobile learners believe the mobile format enhanced their learning. Despite this, mobile access is ranked as the second-largest challenge to learning from an employee's perspective. Tellingly, access to mobile learning doesn't register within the top three perceived challenges L&D professionals face. Looking to the future, 23% plan to purchase mobile learning solutions and this trend is expected to accelerate. Organisations that want to improve the learning experience of their employees need to ensure mobile is part of the solution.

7. Microlearning

Making time for learning isn't easy. Our constantly-connected lifestyles also means that attention spans are shrinking. A solution could lie in Microlearning: this is bite-sized chunks of learning content, completed in three to five minutes, that makes learning easily digestible. Some examples of successful microlearning can be found on popular mediums including:

- podcasts
- blogs

- eLearning
- videos

As a medium, videos are still a popular way to learn. More organisations are turning to mobile devices to create quick, inexpensive, easily uploadable content. According to Training Journal (TJ) "In 2019, we can expect to see even more of this 'guerilla' film production with high-end features with interactivity that will be distributed on mobile devices and applications for easy accessibility."

Online content can be parceled into smaller components, so employees can learn where and when it suits them.

This trend has been driven not only by a better understanding of how we learn, but also by advances in technology. The uptake of mobile and cloud technologies means content can be accessed as needed. This can have a positive impact on a company's bottom line. Organisations that empower their employees with microlearning experience a 63% increase in revenue compared to their peers.

Neuro-physiology of Learning

Many seem to be the points of contact that relate the analysis of studies on the neuro-phenomenological vision of knowledge (and the occurrence of states of consciousness in relation to the act of knowing) and further studies phenomena related to bio physical and neuro-logical that govern and influence the physiology of learning.

A study conducted by several parties on the subject show that individual neurons are able to recognize people, landscapes, objects and even written and names. The finding suggests the existence of a consistent and explicit code that could play a role in the transformation of complex visual representations into long-term memories.

This conception of individual neurons as 'thinking cells' - says the neuro-surgeon Itzhak Fried - represents an important step toward deciphering the code of the cognitive brain. If we can understand this process, maybe one day we will be able to build cognitive prostheses to replace functions lost due to brain injury or disease, and perhaps even to improve memory

Angeles is based on a new conception of the mode of storage of memories, stating that encode memories are small sets of neurons located in specific regions of the brain. These small clusters of neural cells simultaneously represent many aspects of the same thing.

This statement leads to the conclusion that each neuron has its own memory and that groups of neurons fire selectively to images of faces, animals, objects or scenes. In this perspective are here analyzed two different areas of research that are based on two different approaches: one referring to the neuro-phenomenological studies (total embodiment of Varela and Thompson), and the other in reference to the neuro-physiological and bio-medical studies (neurophysiology of learning of Zhuo Joseph Tsien).

But as you can remember the mental states activated by past perceptions and refer back to an object in the world, even when it is not present or does not exist? How is it that a model of external

reality emerges in the physical system, which is the brain? What role has the intentionality and the emergence of consciousness in this process?

The answers to these problems are numerous and controversial and detection of connection points difficult and problematic (hampered by the differentiation of the areas of inquiry: Philosophy of mind, Philosophy of language, Cognitive science, Neuroscience, etc.). This basically means that “Philosophy” speaks little of “Biology” and “Biology” of “Philosophy” speaks even less.

Tsien founded the Shanghai Institute of Brain Functional Genomics at East China Normal University and is now director of the Center for Systems Neurobiology at Boston University. His studies are focused on the search for a neural code that can explain the experience phenomenologically lived through the observation of specific biological processes.

For a long time research of the neural mechanisms by which memories are stored in the brain has been studied by neuroscientists. Learning and memory are very important in the structuring of knowledge: learning is the process by which one acquires knowledge and memory is the process by which knowledge is preserved in time. For many years we have tried, therefore, to investigate the intricacies of cellular memory and to understand the functional basis for action at the neural level.

Tsien and his team, in a biomedical field and through combined and complex experiments, have developed an interesting theory on the basic mechanism by which the brain would be able to transform experience into memory. Clans of neurons involved in coding, they say, make a selection of experiences stored, giving a sense of the

experience and transforming it into knowledge. This extraordinary research could allow, in the near future, to decipher the neural universal code allowing the reading of the memories of a human being by monitoring brain activity. Interesting observations are: a) the nature of the mechanisms of action and the behavior of neural cells, b) the sophisticated mechanism of action research (covering the area CA1 of the hippocampus).

In this theoretical model each event is represented by a group of neuronal clans that encode different characteristics; a clan is represented by a set of neurons that responds in a similar manner to each stimulus, working in harmony in the encoding of events. It is believed, therefore, that it is the clan to generate neural memories, acting in unison on the information conveyed phenomenal experience. Does this mean that behavior is also the derivation of genetic relational nature of man and his predisposition to the “lineage"? (Maturana Dàvila, 2006)

The brain is, in this perspective, the clan for neural discrimination of events encoded in memory. In a threedimensional view, each experience is represented on a pyramid at various levels; each pyramid is considered an integral part of a polyhedron which, in turn, represents the category common to all the pyramids. This model represents a consolidation of memories in a clear and inconceivable way and demonstrate the dynamic nature of the human brain and its extraordinary ability.

organization and on the categorization as universal principles of the functioning of our brain. In the case of memory these properties allow you to create an unlimited number of patterns of neuronal activation (corresponding to the number of experiences that an

organism can live). In this perspective, Tsien and his research team in a recent article say “The ability to learn and remember conspecifics is essential for the establishment and maintenance of social groups. Many animals, including humans, primates and rodents, depend on stable social relationships for survival. Social learning and social recognition have become emerging areas of interest for neuroscientists but are still not well understood. It has been established that several hormones play a role in the modulation of social recognition including estrogen, oxytocin and arginine vasopression. Relatively few studies have investigated how social recognition might be improved or enhanced. In this study,

we investigate the role of the NMDA receptor in social recognition memory, specifically the consequences of altering the ratio of the NR2B:NR2A subunits in the forebrain regions in social behavior. We produced transgenic mice in which the NR2B subunit of the NMDA receptor was overexpressed postnatally in the excitatory neurons of the forebrain areas including the cortex, amygdala and hippocampus. We investigated the ability of both our transgenic animals and their wild-type littermate to learn and remember juvenile conspecifics using both 1-hr and 24-hr memory tests.

Our experiments show that the wild-type animals and NR2B transgenic mice preformed similarly in the 1-hr test. However, transgenic mice showed better performances in 24-hr tests of recognizing animals of a different strain or animals of a different species. We conclude that NR2B overexpression in the forebrain enhances social recognition memory for different strains and animal species”(Jacobs,Tsien, 2012).

Conclusion

That having been said, the paideia-society interrelation stands within a paradigmatic vision of contemporary pedagogy like the double–faced Janus, from which a new dimension of man and citizen arises along with a new way of understanding education//educability of the subject-person (Pastena 2011). It is all about suggesting a new way of interpreting pedagogy where the teaching- learning interaction becomes alternative teaching methodology to the many current practices.

No doubt so much uneasiness and failure to achieve success in the schools are caused by the nature and the way of teaching approaches, by an agency that is often too prone to hyper-didacticisms that bring about confusion and disconcert rather than self-orientating enaction. In fact, enaction means understanding learning as the creation of worlds, where the student experiences the didactic action in structural coupling with the teacher. In short, it is a Paideia that is seen in its atropo-ethical dimension as the hard core that allows interaction (in an enactive circuit) between “sense”, “logic” and “evolution”

What is Memory and Forgetting Memory processes: Encoding, Storage, Retrieval Stages of memory: Sensory memory, Short-term memory (Working memory), Long-term Memory (Declarative – Episodic and Semantic; Procedural)

Theories of Forgetting: Interference, Retrieval Failure, Decay, Motivated forgetting?

Memory and Forgetting Memory processes: Encoding, Storage, Retrieval Stages of memory: Sensory memory, Short-term memory (Working memory), Long-term Memory (Declarative – Episodic and Semantic; Procedural) Theories of Forgetting: Interference, Retrieval Failure, Decay, Motivated forgetting

Memory and Forgetting Memory processes: Encoding, Storage

Human Memory

Human memory, like memory in a computer, allows us to store information for later use. In order to do this, however, both the computer and we need to master three processes involved in memory. The first is called encoding; the process we use to transform information so that it can be stores. For a computer this means transferring data into 1's and 0's. For us, it means transforming the data into a meaningful form such as an association with an existing memory, an image, or a sound.

Next is the actual storage, which simply means holding onto the information. For this to take place, the computer must physically write the 1' and 0's onto the hard drive. It is very similar for us because it means that a physiological change must occur for the memory to be stored. The final process is called retrieval, which is bringing the memory out of storage and reversing the process of encoding. In other words, return the information to a form similar to what we stored.

The major difference between humans and computers in terms of memory has to do with how the information is stored. For the most part, computers have only two types; permanent storage and permanent deletion. Humans, on the other hand are more complex in that we have three distinct memory storage capabilities (not including permanent deletion). The first is Sensory memory, referring to the information we receive through the senses. This memory is very brief lasting only as much as a few seconds.

Short Term Memory(STM) takes over when the information in our sensory memory is transferred to our consciousness or our awareness (Engle, Cantor, & Carullo, 1993; Laming, 1992). This is the information that is currently active such as reading this page, talking to a friend, or writing a paper. Short term memory can definitely last longer than sensory memory (up to 30 seconds or so), but it still has a very limited capacity. According to research, we can remember approximately 5 to 9 (7 +/- 2) bits of information in our short term memory at any given time (Miller, 1956)

If STM lasts only up to 30 seconds, how do we ever get any work done? Wouldn't we start to lose focus or concentrate about twice every minute? This argument prompted researchers to look at a

second phase of STM that is now referred to as Working Memory. Working Memory is the process that takes place when we continually focus on material for longer than STM alone will allow (Baddeley, 1992).

What happens when our short term memory is full and another bit of information enters? Displacement means that the new information will push out part of the old information. Suddenly some one says the area code for that phone number and almost instantly you forget the last two digits of the number. We can further sharpen our short term memory skills, however, by mastering chunking and using rehearsal (which allows us to visualize, hear, say, or even see the information repeatedly and through different senses).

Finally, there is long term memory (LTM), which is most similar to the permanent storage of a computer. Unlike the other two types, LTM is relatively permanent and practically unlimited in terms of its storage capacity. Its been argued that we have enough space in our LTM to memorize every phone number in the U.S. and still function normally in terms of remembering what we do now. Obviously we don't use even a fraction of this storage space.

There are several subcategories of LTM. First, memories for facts, life events, and information about our environment are stored in declarative memory. This includes semantic memory, factual knowledge like the meaning of words, concepts, and our ability to do math (Lesch & Pollatsek, 1993, Rohrer et al., 1995) and episodic memory, memories for events and situations (Goldringer, 1996; Kliegel & Lindberger, 1993). The second subcategory is often not thought of as memory because it refers to internal, rather than external information. When you brush your teeth, write your name,

or scratch your eye, you do this with ease because you previously stored these movements and can recall them with ease. This is referred to as nondeclarative (or implicit) memory. These are memories we have stored due to extensive practice, conditioning, or habits.

Why We Remember What We Remember

Short Term Memory. There are typically six reasons why information is stored in our short term memory.

primacy effect – information that occurs first is typically remembered better than information occurring later. When given a list of words or numbers, the first word or number is usually remembered due to rehearsing this more than other information.

recency effect – often the last bit of information is remembered better because not as much time has past; time which results in forgetting.

distinctiveness – if something stands out from information around it, it is often remembered better. Any distinctive information is easier to remember than that which is similar, usual, or mundane.

frequency effect – rehearsal, as stated in the first example, results in better memory. Remember trying to memorize a formula for your math class. The more you went over it, the better you knew it.

associations – when we associate or attach information to other information it becomes easier to remember. Many of us use this strategy in our professions and everyday life in the form of acronyms.

reconstruction – sometimes we actually fill in the blanks in our memory. In other words, when trying to get a complete picture in our minds, we will make up the missing parts, often without any realization that this is occurring.

Long Term Memory. Information that passes from our short term to our long term memory is typically that which has some significance attached to it. Imagine how difficult it would be to forget the day you graduated, or your first kiss. Now think about how easy it is to forget information that has no significance; the color of the car you parked next to at the store or what shirt you wore last Thursday. When we process information, we attach significance to it and information deemed important is transferred to our long term memory.

There are other reasons information is transferred. As we all know, sometimes our brains seem full of insignificant facts. Repetition plays a role in this, as we tend to remember things more the more they are rehearsed. Other times, information is transferred because it is somehow attached to something significant. You may remember that it was a warm day when you bought your first car. The temperature really plays no important role, but is attached to the memory of buying your first car.

Forgetting

You can't talk about remembering without mentioning its counterpart. It seems that as much as we do remember, we forget even more. Forgetting isn't really all that bad, and is in actuality, a pretty natural phenomenon. Imagine if you remembered every minute detail of every minute or every hour, of every day during your entire life, no matter how good, bad, or insignificant. Now

imagine trying to sift through it all for the important stuff like where you left your keys.

There are many reasons we forget things and often these reasons overlap. Like in the example above, some information never makes it to LTM. Other times, the information gets there, but is lost before it can attach itself to our LTM. Other reasons include decay, which means that information that is not used for an extended period of time decays or fades away over time. It is possible that we are physiologically preprogrammed to eventually erase data that no longer appears pertinent to us.

Failing to remember something doesn't mean the information is gone forever though. Sometimes the information is there but for various reasons we can't access it. This could be caused by distractions going on around us or possibly due to an error of association (e.g., believing something about the data which is not correct causing you to attempt to retrieve information that is not there). There is also the phenomenon of repression, which means that we purposefully (albeit subconsciously) push a memory out of reach because we do not want to remember the associated feelings. This is often sited in cases where adults 'forget' incidences of sexual abuse when they were children. And finally, amnesia, which can be psychological or physiological in origin.

Forgetting is an all too common part of daily life. Sometimes these memory slips are simple and fairly innocuous, such as forgetting to return a phone call. Other times, forgetting can be much more dire and even have serious consequences, such as an eyewitness forgetting important details about a crime.

Memory failures are an almost daily occurrence. Forgetting is so common that you probably rely on numerous methods to help you remember important information, such as jotting down notes in a daily planner or scheduling important events on your phone's calendar.

As you are frantically searching for your missing car keys, it may seem that the information about where you left them is permanently gone from your memory. However, forgetting is generally not about actually losing or erasing this information from your long-term memory.

Time Plays a Key Role in Forgetting

Psychologist Hermann Ebbinghaus was one of the first to scientifically study forgetting. In experiments where he used himself as the subject, Ebbinghaus tested his memory using three-letter nonsense syllables. He relied on such nonsense words because using previously known words would have involved drawing on his existing knowledge and associations in his memory.[2]

In order to test for new information, Ebbinghaus tested his memory for periods of time ranging from 20 minutes to 31 days. He then published his findings in 1885 in Memory: A Contribution to Experimental Psychology.

His results, plotted in what is known as the Ebbinghaus forgetting curve, revealed a relationship between forgetting and time. Initially, information is often lost very quickly after it is learned. Factors such as how the information was learned and how frequently it was rehearsed play a role in how quickly these memories are lost. Information stored in long-term memory is surprisingly stable.

The forgetting curve also showed that forgetting does not continue to decline until all of the information is lost.[2] At a certain point, the amount of forgetting levels off.

How to Measure Forgetting

Sometimes it might seem that information has been forgotten, but even a subtle cue can help trigger the memory. Imagine the last time you took an exam for school. While you might have initially felt forgetful and unprepared, seeing the information presented on the test probably helped cue the retrieval of information you might not have known you even remembered.

So how do we know when something has been forgotten? There are a few different ways to measure this:[3]

- **Recall**: People who have been asked to memorize something, such as a list of terms, might be asked to recall the list from memory. By seeing how many items are remembered, researchers are able to identify how much information has been forgotten. This method might involve the use of free recall (recalling items without hints) or prompted recall (utilizing hints to trigger memories).
- **Recognition**: This method involves identifying information that was previously learned. On a test, for example, students might have to recognize which terms they learned about in a chapter of their assigned reading.

Theories About Why We Forget

Of course, many factors can contribute to forgetting. Sometimes you might be distracted when you learn new information, which might

mean that you never truly retain the information long enough to remember it later. Well-known memory researcher Elizabeth Loftus has proposed four key explanations for why forgetting occurs. These have led to some major theories of forgetting.

Memory processes: Encoding, Storage, Retrieval

"Memory" is a single term that reflects a number of different abilities: holding information briefly while working with it (working memory), remembering episodes of one's life (episodic memory), and our general knowledge of facts of the world (semantic memory), among other types.

Remembering episodes involves three processes: encoding information (learning it, by perceiving it and relating it to past knowledge), storing it (maintaining it over time), and then retrieving it (accessing the information when needed). Failures can occur at any stage, leading to forgetting or to having false memories. The key to improving one's memory is to improve processes of encoding and to use techniques that guarantee effective retrieval.

Good encoding techniques include relating new information to what one already knows, forming mental images, and creating associations among information that needs to be remembered. The key to good retrieval is developing effective cues that will lead the rememberer back to the encoded information. Classic mnemonic systems, known since the time of the ancient Greeks and still used by some today, can greatly improve one's memory abilities.

Key Points

- The three main stages of memory are encoding, storage, and retrieval. Problems can occur at any of these stages.
- The three main forms of memory storage are sensory memory, short-term memory, and long-term memory.
- Sensory memory is not consciously controlled; it allows individuals to retain impressions of sensory information after the original stimulus has ceased.
- Short-term memory lasts for a very brief time and can only hold 7 +/- 2 pieces of information at once.
- Long-term storage can hold an indefinitely large amount of information and can last for a very long time.
- Implicit and explicit memories are two different types of long-term memory. Implicit memories are of sensory and automatized behaviors, and explicit memories are of information, episodes, or events.

Key Terms

- **memory**: The ability of an organism to record information about things or events with the facility of recalling them later at will.
- **rehearsal**: Repetition of an item in short-term memory in order to store it in long-term memory.

Memory is the ability to take in information, store it, and recall it at a later time. In psychology, memory is broken into three stages: encoding, storage, and retrieval. **The Memory Process**

1. Encoding (or registration): the process of receiving, processing, and combining information. Encoding allows information from the outside world to reach our senses in the forms of chemical and physical stimuli. In this first stage we must change the information so that we may put the memory into the encoding process.
2. Storage: the creation of a permanent record of the encoded information. Storage is the second memory stage or process in which we maintain information over periods of time.
3. Retrieval (or recall, or recognition): the calling back of stored information in response to some cue for use in a process or activity. The third process is the retrieval of information that we have stored. We must locate it and return it to our consciousness. Some retrieval attempts may be effortless due to the type of information.

Problems can occur at any stage of the process, leading to anything from forgetfulness to amnesia. Distraction can prevent us from encoding information initially; information might not be stored properly, or might not move from short-term to long-term storage; and/or we might not be able to retrieve the information once it's stored.

Memory Encoding

Our memory has three basic functions: encoding, storing, and retrieving information. Encoding is the act of getting information into our memory system through automatic or effortful processing. Storage is retention of the information, and retrieval is the act of getting information out of storage and into conscious awareness

through recall, recognition, and relearning. There are various models that aim to explain how we utilize our memory. In this section, you'll learn about some of these models as well as the importance of recall, recognition, and relearning.

Encoding

We get information into our brains through a process called **encoding**, which is the input of information into the memory system. Once we receive sensory information from the environment, our brains label or code it. We organize the information with other similar information and connect new concepts to existing concepts. Encoding information occurs through automatic processing and effortful processing. If someone asks you what you ate for lunch today, more than likely you could recall this information quite easily. This is known as **automatic processing**, or the encoding of details like time, space, frequency, and the meaning of words. Automatic processing is usually done without any conscious awareness. Recalling the last time you studied for a test is another example of automatic processing. But what about the actual test material you studied? It probably required a lot of work and attention on your part in order to encode that information.

What are the most effective ways to ensure that important memories are well encoded? Even a simple sentence is easier to recall when it is meaningful (Anderson, 1984). Read the following sentences (Bransford & McCarrell, 1974), then look away and count backwards from 30 by threes to zero, and then try to write down the sentences (no peeking back at this page!).

1. The notes were sour because the seams split.

2. The voyage wasn't delayed because the bottle shattered.
3. The haystack was important because the cloth ripped.

How well did you do? By themselves, the statements that you wrote down were most likely confusing and difficult for you to recall. Now, try writing them again, using the following prompts: bagpipe, ship christening (shattering a bottle over the bow of the ship is a symbol of good luck), and parachutist. Next count backwards from 40 by fours, then check yourself to see how well you recalled the sentences this time. You can see that the sentences are now much more memorable because each of the sentences was placed in context. Material is far better encoded when you make it meaningful.

There are three types of encoding. The encoding of words and their meaning is known as **semantic encoding**. It was first demonstrated by William Bousfield (1935) in an experiment in which he asked people to memorize words. The 60 words were actually divided into 4 categories of meaning, although the participants did not know this because the words were randomly presented. When they were asked to remember the words, they tended to recall them in categories, showing that they paid attention to the meanings of the words as they learned them.

Visual encoding is the encoding of images, and **acoustic encoding** is the encoding of sounds, words in particular. To see how visual encoding works, read over this list of words: car, level, dog, truth, book, value. If you were asked later to recall the words from this list, which ones do you think you'd most likely remember? You would probably have an easier time recalling the words car, dog, and book, and a more difficult time recalling the words level,

truth, and value. Why is this? Because you can recall images (mental pictures) more easily than words alone. When you read the words car, dog, and book you created images of these things in your mind. These are concrete, high-imagery words. On the other hand, abstract words like level, truth, and value are low-imagery words. High-imagery words are encoded both visually and semantically (Paivio, 1986), thus building a stronger memory.

Now let's turn our attention to acoustic encoding. You are driving in your car and a song comes on the radio that you haven't heard in at least 10 years, but you sing along, recalling every word. In the United States, children often learn the alphabet through song, and they learn the number of days in each month through rhyme: "Thirty days hath September, / April, June, and November; / All the rest have thirty-one, / Save February, with twenty-eight days clear, / And twenty-nine each leap year." These lessons are easy to remember because of acoustic encoding. We encode the sounds the words make. This is one of the reasons why much of what we teach young children is done through song, rhyme, and rhythm.

Which of the three types of encoding do you think would give you the best memory of verbal information? Some years ago, psychologists Fergus Craik and Endel Tulving (1975) conducted a series of experiments to find out. Participants were given words along with questions about them. The questions required the participants to process the words at one of the three levels. The visual processing questions included such things as asking the participants about the font of the letters. The acoustic processing questions asked the participants about the sound or rhyming of the words, and the semantic processing questions asked the participants about the meaning of the words. After participants were

presented with the words and questions, they were given an unexpected recall or recognition task.

Words that had been encoded semantically were better remembered than those encoded visually or acoustically. Semantic encoding involves a deeper level of processing than the shallower visual or acoustic encoding. Craik and Tulving concluded that we process verbal information best through semantic encoding, especially if we apply what is called the self-reference effect. The self-reference effect is the tendency for an individual to have better memory for information that relates to oneself in comparison to material that has less personal relevance (Rogers, Kuiper & Kirker, 1977).

Recoding

The process of encoding is selective, and in complex situations, relatively few of many possible details are noticed and encoded. The process of encoding always involves **recoding**—that is, taking the information from the form it is delivered to us and then converting it in a way that we can make sense of it. For example, you might try to remember the colors of a rainbow by using the acronym ROY G BIV (red, orange, yellow, green, blue, indigo, violet). The process of recoding the colors into a name can help us to remember. However, recoding can also introduce errors—when we accidentally add information during encoding, then remember that new material as if it had been part of the actual experience (as discussed below).

Varieties of Memory

To be a good chess player you have to learn to increase working memory so you can plan ahead for several offensive moves while simultaneously anticipating - through use of memory - how the other player could counter each of your planned moves. [Image: karpidis, https://goo.gl/EhzMKM, CC BY-SA 2.0, https://goo.gl/jSSrcO]

For most of us, remembering digits relies on short-term memory, or working memory—the ability to hold information in our minds for a brief time and work with it (e.g., multiplying 24 x 17

without using paper would rely on working memory). Another type of memory is

episodic memory—the ability to remember the episodes of our lives. If you were given the task of recalling everything you did 2 days ago, that would be a test of episodic memory; you would be required to mentally travel through the day in your mind and note the main events.

Semantic memory

is our storehouse of more-or-less permanent knowledge, such as the meanings of words in a language (e.g., the meaning of "parasol") and the huge collection of facts about the world (e.g., there are 196 countries in the world, and 206 bones in your body). Collective memory refers to the kind of memory that people in a group share (whether family, community, schoolmates, or citizens of a state or a country). For example, residents of small towns often strongly identify with those towns, remembering the local customs and historical events in a unique way. That is, the community's collective memory passes stories and recollections between neighbors and to future generations, forming a memory system unto itself.

Psychologists continue to debate the classification of types of memory, as well as which types rely on others (Tulving, 2007), but for this module we will focus on episodic memory. Episodic memory is usually what people think of when they hear the word "memory." For example, when people say that an older relative is "losing her memory" due to Alzheimer's disease, the type of memory-loss they are referring to is the inability to recall events, or episodic memory. (Semantic memory is actually preserved in early-stage Alzheimer's

disease.) Although remembering specific events that have happened over the course of one's entire life (e.g., your experiences in sixth grade) can be referred to as **autobiographical memory**, we will focus primarily on the episodic memories of more recent events.

Storage Memory

Every experience we have changes our brains. That may seem like a bold, even strange, claim at first, but it's true. We encode each of our experiences within the structures of the nervous system, making new impressions in the process—and each of those impressions involves changes in the brain. Psychologists (and neurobiologists) say that experiences leave **memory traces**, or **engrams** (the two terms are synonyms).

Memories have to be stored somewhere in the brain, so in order to do so, the brain biochemically alters itself and its neural tissue. Just like you might write yourself a note to remind you of something, the brain "writes" a memory trace, changing its own physical composition to do so. The basic idea is that events (occurrences in our environment) create engrams through a process of **consolidation**: the neural changes that occur after learning to create the memory trace of an experience. Although neurobiologists are concerned with exactly what neural processes change when memories are created, for psychologists, the term memory trace simply refers to the physical change in the nervous system (whatever that may be, exactly) that represents our experience.

Although the concept of engram or memory trace is extremely useful, we shouldn't take the term too literally. It is important to understand that memory traces are not perfect little packets of information that lie dormant in the brain, waiting to be called forward to give an accurate report of past experience. Memory traces are not like video or audio recordings, capturing experience with great accuracy; as discussed earlier, we often have errors in our memory, which would not exist if memory traces were perfect packets of information.

Thus, it is wrong to think that remembering involves simply "reading out" a faithful record of past experience. Rather, when we remember past events, we reconstruct them with the aid of our memory traces—but also with our current belief of what happened. For example, if you were trying to recall for the police who started a fight at a bar, you may not have a memory trace of who pushed whom first. However, let's say you remember that one of the guys held the door open for you. When thinking back to the start of the fight, this knowledge (of how one guy was friendly to you) may unconsciously influence your memory of what happened in favor of the nice guy. Thus, memory is a construction of what you actually recall and what you believe happened. In a phrase, remembering is reconstructive (we reconstruct our past with the aid of memory traces) not reproductive (a perfect reproduction or recreation of the past).

Psychologists refer to the time between learning and testing as the retention interval. Memories can consolidate during that time, aiding retention. However, experiences can also occur that undermine the memory. For example, think of what you had for lunch yesterday—a pretty easy task. However, if you had to recall what you had for

lunch 17 days ago, you may well fail (assuming you don't eat the same thing every day). The 16 lunches you've had since that one have created **retroactive interference**. Retroactive interference refers to new activities (i.e., the subsequent lunches) during the retention interval (i.e., the time between the lunch 17 days ago and now) that interfere with retrieving the specific, older memory (i.e., the lunch details from 17 days ago). But just as newer things can interfere with remembering older things, so can the opposite happen. Proactive interference is when past memories interfere with the encoding of new ones. For example, if you have ever studied a second language, often times the grammar and vocabulary of your native language will pop into your head, impairing your fluency in the foreign language.

in which she shows how memory for an event can be changed via misinformation supplied during the retention interval. For example, if you witnessed a car crash but subsequently heard people describing it from their own perspective, this new information may interfere with or disrupt your own personal recollection of the crash. In fact, you may even come to remember the event happening exactly as the others described it! This **misinformation effect** in eyewitness memory represents a type of retroactive interference that can occur during the retention interval (see Loftus [2005] for a review). Of course, if correct information is given during the retention interval, the witness's memory will usually be improved.

Retrieval Memory

Endel Tulving argued that "the key process in memory is retrieval" (1991, p. 91). Why should retrieval be given more prominence than encoding or storage? For one thing, if information were encoded

and stored but could not be retrieved, it would be useless. As discussed previously in this module, we encode and store thousands of events—conversations, sights and sounds—every day, creating memory traces. However, we later access only a tiny portion of what we've taken in. Most of our memories will never be used—in the sense of being brought back to mind, consciously. This fact seems so obvious that we rarely reflect on it. All those events that happened to you in the fourth grade that seemed so important then? Now, many years later, you would struggle to remember even a few. You may wonder if the traces of those memories still exist in some latent form. Unfortunately, with currently available methods, it is impossible to know.

Psychologists distinguish information that is available in memory from that which is accessible (Tulving & Pearlstone, 1966). Available information is the information that is stored in memory—but precisely how much and what types are stored cannot be known. That is, all we can know is what information we can retrieve—accessible information. The assumption is that accessible information represents only a tiny slice of the information available in our brains. Most of us have had the experience of trying to remember some fact or event, giving up, and then—all of a sudden!—it comes to us at a later time, even after we've stopped trying to remember it. Similarly, we all know the experience of failing to recall a fact, but then, if we are given several choices (as in a multiple-choice test), we are easily able to recognize it.

What factors determine what information can be retrieved from memory? One critical factor is the type of hints, or cues, in the environment. You may hear a song on the radio that suddenly evokes memories of an earlier time in your life, even if you were not

trying to remember it when the song came on. Nevertheless, the song is closely associated with that time, so it brings the experience to mind.

The general principle that underlies the effectiveness of retrieval cues is the **encoding specificity principle** (Tulving & Thomson, 1973): when people encode information, they do so in specific ways. For example, take the song on the radio: perhaps you heard it while you were at a terrific party, having a great, philosophical conversation with a friend. Thus, the song became part of that whole complex experience. Years later, even though you haven't thought about that party in ages, when you hear the song on the radio, the whole experience rushes back to you. In general, the encoding specificity principle states that, to the extent a retrieval cue (the song) matches or overlaps the memory trace of an experience (the party, the conversation), it will be effective in evoking the memory. A classic experiment on the encoding specificity principle had participants memorize a set of words in a unique setting. Later, the participants were tested on the word sets, either in the same location they learned the words or a different one. As a result of encoding specificity, the students who took the test in the same place they learned the words were actually able to recall more words (Godden & Baddeley, 1975) than the students who took the test in a new setting.

One caution with this principle, though, is that, for the cue to work, it can't match too many other experiences (Nairne, 2002; Watkins, 1975). Consider a lab experiment. Suppose you study 100 items; 99 are words, and one is a picture—of a penguin, item 50 in the list. Afterwards, the cue "recall the picture" would evoke "penguin" perfectly. No one would miss it. However, if the word "penguin" were

placed in the same spot among the other 99 words, its memorability would be exceptionally worse. This outcome shows the power of distinctiveness that we discussed in the section on encoding: one picture is perfectly recalled from among 99 words because it stands out. Now consider what would happen if the experiment were repeated, but there were 25 pictures distributed within the 100-item list. Although the picture of the penguin would still be there, the probability that the cue "recall the picture" (at item 50) would be useful for the penguin would drop correspondingly. Watkins (1975) referred to this outcome as demonstrating the **cue overload principle**. That is, to be effective, a retrieval cue cannot be overloaded with too many memories. For the cue "recall the picture" to be effective, it should only match one item in the target set (as in the one-picture, 99-word case).

To sum up how memory cues function: for a retrieval cue to be effective, a match must exist between the cue and the desired target memory; furthermore, to produce the best retrieval, the cue-target relationship should be distinctive. Next, we will see how the encoding specificity principle can work in practice.

Psychologists measure memory performance by using production tests (involving recall) or recognition tests (involving the selection of correct from incorrect information, e.g., a multiple-choice test). For example, with our list of 100 words, one group of people might be asked to recall the list in any order (a free recall test), while a different group might be asked to circle the 100 studied words out of a mix with another 100, unstudied words (a recognition test). In this situation, the recognition test would likely produce better performance from participants than the recall test.

We usually think of recognition tests as being quite easy, because the cue for retrieval is a copy of the actual event that was presented for study. After all, what could be a better cue than the exact target (memory) the person is trying to access? In most cases, this line of reasoning is true; nevertheless, recognition tests do not provide perfect indexes of what is stored in memory. That is, you can fail to recognize a target staring you right in the face, yet be able to recall it later with a different set of cues (Watkins & Tulving, 1975). For example, suppose you had the task of recognizing the surnames of famous authors. At first, you might think that being given the actual last name would always be the best cue. However, research has shown this not necessarily to be true (Muter, 1984). When given names such as Tolstoy, Shaw, Shakespeare, and Lee, subjects might well say that Tolstoy and Shakespeare are famous authors, whereas Shaw and Lee are not. But, when given a cued recall test using first names, people often recall items (produce them) that they had failed to recognize before. For example, in this instance, a cue like George Bernard _____ often leads to a recall of "Shaw," even though people initially failed to recognize Shaw as a famous author's name. Yet, when given the cue "William," people may not come up with Shakespeare, because William is a common name that matches many people (the cue overload principle at work). This strange fact—that recall can sometimes lead to better performance than recognition—can be explained by the encoding specificity principle. As a cue, George Bernard _____ matches the way the famous writer is stored in memory better than does his surname, Shaw, does (even though it is the target). Further, the match is quite distinctive with George Bernard _____, but the cue William _____ is much more overloaded (Prince William, William Yeats, William Faulkner, will.i.am).

The phenomenon we have been describing is called the recognition failure of recallable words, which highlights the point that a cue will be most effective depending on how the information has been encoded (Tulving & Thomson, 1973). The point is, the cues that work best to evoke retrieval are those that recreate the event or name to be remembered, whereas sometimes even the target itself, such as Shaw in the above example, is not the best cue. Which cue will be most effective depends on how the information has been encoded.

Whenever we think about our past, we engage in the act of retrieval. We usually think that retrieval is an objective act because we tend to imagine that retrieving a memory is like pulling a book from a shelf, and after we are done with it, we return the book to the shelf just as it was. However, research shows this assumption to be false; far from being a static repository of data, the memory is constantly changing. In fact, every time we retrieve a memory, it is altered. For example, the act of retrieval itself (of a fact, concept, or event) makes the retrieved memory much more likely to be retrieved again, a phenomenon called the testing effect or the retrieval practice effect (Pyc & Rawson, 2009; Roediger & Karpicke, 2006). However, retrieving some information can actually cause us to forget other information related to it, a phenomenon called retrieval-induced forgetting (Anderson, Bjork, & Bjork, 1994). Thus the act of retrieval can be a double-edged sword—strengthening the memory just retrieved (usually by a large amount) but harming related information (though this effect is often relatively small).

As discussed earlier, retrieval of distant memories is reconstructive. We weave the concrete bits and pieces of events in with assumptions and preferences to form a coherent story (Bartlett,

1932). For example, if during your 10th birthday, your dog got to your cake before you did, you would likely tell that story for years afterward. Say, then, in later years you misremember where the dog actually found the cake, but repeat that error over and over during subsequent retellings of the story. Over time, that inaccuracy would become a basic fact of the event in your mind. Just as retrieval practice (repetition) enhances accurate memories, so will it strengthen errors or false memories (McDermott, 2006). Sometimes memories can even be manufactured just from hearing a vivid story. Consider the following episode, recounted by Jean Piaget, the famous developmental psychologist, from his childhood:

One of my first memories would date, if it were true, from my second year. I can still see, most clearly, the following scene, in which I believed until I was about 15. I was sitting in my pram . . . when a man tried to kidnap me. I was held in by the strap fastened round me while my nurse bravely tried to stand between me and the thief. She received various scratches, and I can still vaguely see those on her face. . . . When I was about 15, my parents received a letter from my former nurse saying that she had been converted to the Salvation Army. She wanted to confess her past faults, and in particular to return the watch she had been given as a reward on this occasion. She had made up the whole story, faking the scratches. I therefore must have heard, as a child, this story, which my parents believed, and projected it into the past in the form of a visual memory. . . . Many real memories are doubtless of the same order. (Norman & Schacter, 1997, pp. 187–188)

Piaget's vivid account represents a case of a pure reconstructive memory. He heard the tale told repeatedly, and doubtless told it (and thought about it) himself. The repeated telling cemented the

events as though they had really happened, just as we are all open to the possibility of having "many real memories ... of the same order." The fact that one can remember precise details (the location, the scratches) does not necessarily indicate that the memory is true, a point that has been confirmed in laboratory studies, too (e.g., Norman & Schacter, 1997).

Putting It All Together: Improving Your Memory

A central theme of this module has been the importance of the encoding and retrieval processes, and their interaction. To recap: to improve learning and memory, we need to encode information in conjunction with excellent cues that will bring back the remembered events when we need them. But how do we do this? Keep in mind the two critical principles we have discussed: to maximize retrieval, we should construct meaningful cues that remind us of the original experience, and those cues should be distinctive and not associated with other memories. These two conditions are critical in maximizing cue effectiveness (Nairne, 2002).

So, how can these principles be adapted for use in many situations? Let's go back to how we started the module, with Simon Reinhard's ability to memorize huge numbers of digits. Although it was not obvious, he applied these same general memory principles, but in a more deliberate way. In fact, all **mnemonic devices**, or memory aids/tricks, rely on these fundamental principles. In a typical case, the person learns a set of cues and then applies these cues to learn and remember information. Consider the set of 20 items below that are easy to learn and remember (Bower & Reitman, 1972).

1. is a gun. 11 is penny-one, hot dog bun.

2. is a shoe. 12 is penny-two, airplane glue.
3. is a tree. 13 is penny-three, bumble bee.
4. is a door. 14 is penny-four, grocery store.
5. is knives. 15 is penny-five, big beehive.
6. is sticks. 16 is penny-six, magic tricks.
7. is oven. 17 is penny-seven, go to heaven.
8. is plate. 18 is penny-eight, golden gate.
9. is wine. 19 is penny-nine, ball of twine.
10. is hen. 20 is penny-ten, ballpoint pen.

It would probably take you less than 10 minutes to learn this list and practice recalling it several times (remember to use retrieval practice!). If you were to do so, you would have a set of peg words on which you could “hang” memories. In fact, this mnemonic device is called the peg word technique. If you then needed to remember some discrete items—say a grocery list, or points you wanted to make in a speech—this method would let you do so in a very precise yet flexible way. Suppose you had to remember bread, peanut butter, bananas, lettuce, and so on. The way to use the method is to form a vivid image of what you want to remember and imagine it interacting with your peg words (as many as you need). For example, for these items, you might imagine a large gun (the first peg word) shooting a loaf of bread, then a jar of peanut butter inside a shoe, then large bunches of bananas hanging from a tree, then a door slamming on a head of lettuce with leaves flying everywhere. The idea is to provide good, distinctive cues (the

weirder the better!) for the information you need to remember while you are learning it. If you do this, then retrieving it later is relatively easy. You know your cues perfectly (one is gun, etc.), so you simply go through your cue word list and "look" in your mind's eye at the image stored there (bread, in this case).

This peg word method may sound strange at first, but it works quite well, even with little training (Roediger, 1980). One word of warning, though, is that the items to be remembered need to be presented

relatively slowly at first, until you have practice associating each with its cue word. People get faster with time. Another interesting aspect of this technique is that it's just as easy to recall the items in backwards order as forwards. This is because the peg words provide direct access to the memorized items, regardless of order.

How did Simon Reinhard remember those digits? Essentially he has a much more complex system based on these same principles. In his case, he uses "memory palaces" (elaborate scenes with discrete places) combined with huge sets of images for digits. For example, imagine mentally walking through the home where you grew up and identifying as many distinct areas and objects as possible. Simon has hundreds of such memory palaces that he uses. Next, for remembering digits, he has memorized a set of 10,000 images. Every four-digit number for him immediately brings forth a mental image. So, for example, 6187 might recall Michael Jackson. When Simon hears all the numbers coming at him, he places an image for every four digits into locations in his memory palace. He can do this at an incredibly rapid rate, faster than 4 digits per 4 seconds when they are flashed visually, as in the demonstration at the beginning of the module. As noted, his record is 240 digits, recalled in exact order. Simon also holds the world record in an event called "speed cards," which involves memorizing the precise order of a shuffled deck of cards. Simon was able to do this in 21.19 seconds! Again, he uses his memory palaces, and he encodes groups of cards as single images.

Many books exist on how to improve memory using mnemonic devices, but all involve forming distinctive encoding operations and then having an infallible set of memory cues. We should add that to develop and use these memory systems beyond the basic peg

system outlined above takes a great amount of time and concentration. The World Memory Championships are held every year and the records keep improving. However, for most common purposes, just keep in mind that to remember well you need to encode information in a distinctive way and to have good cues for retrieval. You can adapt a system that will meet most any purpose.

Stages of memory: Sensory memory, Short-term memory (Working memory), Long-term Memory (Declarative – Episodic and Semantic; Procedural)

Types of Memory

Sensory Memory

Sensory memory allows individuals to retain impressions of sensory information after the original stimulus has ceased. One of the most common examples of sensory memory is fast-moving lights in darkness: if you've ever lit a sparkler on the Fourth of July or watched traffic rush by at night, the light appears to leave a trail. This is because of "iconic memory," the visual sensory store. Two other types of sensory memory have been extensively studied: echoic memory (the auditory sensory store) and haptic memory (the tactile sensory store). Sensory memory is not involved in higher cognitive functions like short- and long-term memory; it is not consciously controlled. The role of sensory memory is to provide a detailed representation of our entire sensory experience for which relevant pieces of information are extracted by short-term memory and processed by working memory.

KEY TAKEAWAYS

Key Points

- Sensory memory allows individuals to recall great detail about a complex stimulus immediately following its presentation.
- There are different types of sensory memory, including iconic memory, echoic memory, and haptic memory.
- In sensory memory, no manipulation of the incoming information occurs, and the input is quickly transferred to the working memory.

Key Terms

- **sensory memory**: The brief storage (in memory) of information experienced by the senses; typically only lasts up to a few seconds.
- **iconic**: Visually representative.
- **echoic**: Imitative of a sound; onomatopoeic.

Sensory memory allows individuals to retain impressions of sensory information for a brief time after the original stimulus has ceased. It allows individuals to remember great sensory detail about a complex stimulus immediately following its presentation. Sensory memory is an automatic response considered to be outside of cognitive control. The information represented in this type of memory is the “raw data” which provides a snapshot of a person’s overall sensory experience. Information from sensory memory has the shortest retention time, ranging from mere milliseconds to five seconds. It is retained just long enough for it to be transferred to short-term (working) memory.

In sensory memory, no manipulation of the incoming information occurs as it is transferred quickly to working memory. The amount of information is greatly reduced during this transfer because the capacity of working memory is not large enough to cope with all the input coming from our sense organs.

Types of Sensory Memory

It is assumed that there is a subtype of sensory memory for each of the five major senses (touch, taste, sight, hearing, and smell); however, only three of these types have been extensively studied: echoic memory, iconic memory, and haptic memory.

Iconic Memory

Sensory input to the visual system goes into iconic memory, so named because the mental representations of visual stimuli are referred to as icons. Iconic memory has a duration of about 100 ms. One of the times that iconic memory is noticeable is when we see “light trails.” This is the phenomenon when bright lights move rapidly at night and you perceive them as forming a trail; this is the image that is represented in iconic memory.

Light trails: In iconic memory, you perceive a moving bright light as forming a continuous line because of the images retained in sensory memory for milliseconds.

Echoic Memory

Echoic memory is the branch of sensory memory used by the auditory system. Echoic memory is capable of holding a large amount of auditory information, but only for 3–4 seconds. This echoic sound is replayed in the mind for this brief amount of time immediately after the presentation of the auditory stimulus.

Haptic Memory

Haptic memory is the branch of sensory memory used by the sense of touch. Sensory receptors all over the body detect sensations like pressure, itching, and pain, which are briefly held in haptic memory before vanishing or being transported to short-term memory. This type of memory seems to be used when assessing the necessary forces for gripping and interacting with familiar objects. Haptic memory seems to decay after about two seconds. Evidence of haptic memory has only recently been identified and not as much is known about its characteristics compared to iconic memory.

Short-Term Memory

Short-term memory is also known as working memory. It holds only a few items (research shows a range of 7 +/- 2 items) and only lasts for about 20 seconds. However, items can be moved from short-term memory to long-term memory via processes like rehearsal. An example of rehearsal is when someone gives you a phone number verbally and you say it to yourself repeatedly until you can write it down. If someone interrupts your rehearsal by asking a question, you can easily forget the number, since it is only being held in your short-term memory.

KEY TAKEAWAYS

Key Points

- Short-term memory acts as a scratchpad for temporary recall of information being processed. It decays rapidly and has a limited capacity.

- Rehearsal and chunking are two ways to make information more likely to be held in short-term memory.
- Working memory is related to short-term memory. It contains a phonological loop that preserves verbal and auditory data, a visuospatial scratchpad that preserves visual data, and a central manager that controls attention to the data.

Key Terms

- **chunking**: The splitting of information into smaller pieces to make reading and understanding faster and easier.
- **encoding**: The process of converting information into a construct that can be stored within the brain.
- **consolidation**: A process that stabilizes a memory trace after its initial acquisition.

Short-term memory is the capacity for holding a small amount of information in an active, readily available state for a brief period of time. It is separate from our long-term memory, where lots of information is stored for us to recall at a later time. Unlike sensory memory, it is capable of temporary storage. How long this storage lasts depends on conscious effort from the individual; without rehearsal or active maintenance, the duration of short-term memory is believed to be on the order of seconds.

Capacity of Short-Term Memory

Short-term memory acts as a scratchpad for temporary recall of information. For instance, in order to understand this sentence you need to hold in your mind the beginning of the sentence as you read

the rest. Short-term memory decays rapidly and has a limited capacity.

The psychologist George Miller suggested that human short-term memory has a forward memory span of approximately seven items plus or minus two. More recent research has shown that this number is roughly accurate for college students recalling lists of digits, but memory span varies widely with populations tested and with material used.

For example, the ability to recall words in order depends on a number of characteristics of these words: fewer words can be recalled when the words have longer spoken duration (this is known as the word-length effect) or when their speech sounds are similar to each other (this is called the phonological similarity effect). More words can be recalled when the words are highly familiar or occur frequently in the language. Chunking of information can also lead to an increase in short-term memory capacity. For example, it is easier to remember a hyphenated phone number than a single long number because it is broken into three chunks instead of existing as ten digits.

Rehearsal is the process in which information is kept in short-term memory by mentally repeating it. When the information is repeated each time, that information is re-entered into the short-term memory, thus keeping that information for another 10 to 20 seconds, the average storage time for short-term memory. Distractions from rehearsal often cause disturbances in short-term memory retention. This accounts for the desire to complete a task held in short-term memory as soon as possible.

Working Memory

Though the term “working memory” is often used synonymously with “short-term memory,” working memory is related to but actually distinct from short-term memory. It holds temporary data in the mind where it can be manipulated. Baddeley and Hitch’s 1974 model of working memory is the most commonly accepted theory of working memory today. According to Baddeley, working memory has a phonological loop to preserve verbal data, a visuospatial scratchpad to control visual data, and a central executive to disperse attention between them.

Phonological Loop

The phonological loop is responsible for dealing with auditory and verbal information, such as phone numbers, people’s names, or general understanding of what other people are talking about. We could roughly say that it is a system specialized for language. It consists of two parts: a short-term phonological store with auditory memory traces that are subject to rapid decay, and an articulatory loop that can revive these memory traces. The phonological store can only store sounds for about two seconds without rehearsal, but the auditory loop can “replay them” internally to keep them in working memory. The repetition of information deepens the memory.

Visuospatial Sketchpad

Visual and spatial information is handled in the visuospatial sketchpad. This means that information about the position and properties of objects can be stored. The phonological loop and visuospatial sketchpad are semi-independent systems; because of this, you can increase the amount you can remember by engaging both systems at once. For instance, you might be better able to

remember an entire phone number if you visualize part of it (using the visuospatial sketchpad) and then say the rest of it out loud (using the phonological loop).

Central Executive

The central executive connects the phonological loop and the visuospatial sketchpad and coordinates their activities. It also links the working memory to the long-term memory, controls the storage of long-term memory, and manages memory retrieval from storage. The process of storage is influenced by the duration in which information is held in working memory and the amount that the information is manipulated. Information is stored for a longer time if it is semantically interpreted and viewed with relation to other information already stored in long-term memory.

Transport to Long-Term Memory

The process of transferring information from short-term to long-term memory involves encoding and consolidation of information. This is a function of time; that is, the longer the memory stays in the short-term memory the more likely it is to be placed in the long-term memory. In this process, the meaningfulness or emotional content of an item may play a greater role in its retention in the long-term memory.

This greater retention is owed to an enhanced synaptic response within the hippocampus, which is essential for memory storage. The limbic system of the brain (including the hippocampus and amygdala) is not necessarily directly involved in long-term memory, but it selects particular information from short-term memory and

consolidates these memories by playing them like a continuous tape.

Long-Term Memory

Long-term memories are all the memories we hold for periods of time longer than a few seconds; long-term memory encompasses everything from what we learned in first grade to our old addresses to what we wore to work yesterday. Long-term memory has an incredibly vast storage capacity, and some memories can last from the time they are created until we die.

There are many types of long-term memory. Explicit or declarative memory requires conscious recall; it consists of information that is consciously stored or retrieved. Explicit memory can be further subdivided into semantic memory (facts taken out of context, such as “Paris is the capital of France”) and episodic memory (personal experiences, such as “When I was in Paris, I saw the Mona Lisa“).

In contrast to explicit/declarative memory, there is also a system for procedural/implicit memory. These memories are not based on consciously storing and retrieving information, but on implicit learning. Often this type of memory is employed in learning new motor skills. An example of implicit learning is learning to ride a bike: you do not need to consciously remember how to ride a bike, you simply do. This is because of implicit memory.

KEY TAKEAWAYS

Key Points

- Long-term memory is the final, semi-permanent stage of memory; it has a theoretically infinite capacity, and information can remain there indefinitely.
- Long-term memories can be categorized as either explicit or implicit memories.
- Explicit memories involve facts, concepts, and events, and must be recalled consciously.
- Explicit memories can be either semantic (abstract, fact-based) or episodic (based on a specific event).
- Implicit memories are procedures for completing motor actions.

Key Terms

- **long-term memory**: Memory in which associations among items are stored indefinitely; part of the theory of a dual-store memory model.
- **script**: A “blueprint” or routine for dealing with a specific situation.

If we want to remember something tomorrow, we have to consolidate it into long-term memory today. Long-term memory is the final, semi-permanent stage of memory. Unlike sensory and short-term memory, long-term memory has a theoretically infinite capacity, and information can remain there indefinitely. Long-term memory has also been called reference memory, because an individual must refer to the information in long-term memory when performing almost any task. Long-term memory can be broken down into two categories: explicit and implicit memory.

Explicit Memory

Explicit memory, also known as conscious or declarative memory, involves memory of facts, concepts, and events that require conscious recall of the information. In other words, the individual must actively think about retrieving the information from memory. This type of information is explicitly stored and retrieved—hence its name. Explicit memory can be further subdivided into semantic memory, which concerns facts, and episodic memory, which concerns primarily personal or autobiographical information.

Semantic Memory

Semantic memory involves abstract factual knowledge, such as "Albany is the capital of New York." It is for the type of information that we learn from books and school: faces, places, facts, and concepts. You use semantic memory when you take a test. Another type of semantic memory is called a script. Scripts are like blueprints of what tends to happen in certain situations. For example, what usually happens if you visit a restaurant? You get the menu, you order your meal, you eat it, and then you pay the bill. Through practice, you learn these scripts and encode them into semantic memory.

Episodic Memory

Episodic memory is used for more contextualized memories. They are generally memories of specific moments, or episodes, in one's life. As such, they include sensations and emotions associated with the event, in addition to the who, what, where, and when of what happened. An example of an episodic memory would be recalling your family's trip to the beach. Autobiographical memory (memory

for particular events in one's own life) is generally viewed as either equivalent to, or a subset of, episodic memory. One specific type of autobiographical memory is a flashbulb memory, which is a highly detailed, exceptionally vivid "snapshot" of the moment and circumstances in which a piece of surprising and consequential (or emotionally arousing) news was heard. For example, many people remember exactly where they were and what they were doing when they heard of the terrorist attacks on September 11, 2001. This is because it is a flashbulb memory.

Semantic and episodic memory are closely related; memory for facts can be enhanced with episodic memories associated with the fact, and vice versa. For example, the answer to the factual question "Are all apples red?" might be recalled by remembering the time you saw someone eating a green apple. Likewise, semantic memories about certain topics, such as football, can contribute to more detailed episodic memories of a particular personal event, like watching a football game. A person that barely knows the rules of football will remember the various plays and outcomes of the game in much less detail than a football expert.

Implicit Memory

In contrast to explicit (conscious) memory, implicit (also called "unconscious" or "procedural") memory involves procedures for completing actions. These actions develop with practice over time. Athletic skills are one example of implicit memory. You learn the fundamentals of a sport, practice them over and over, and then they flow naturally during a game. Rehearsing for a dance or musical performance is another example of implicit memory. Everyday examples include remembering how to tie your shoes, drive a car,

or ride a bicycle. These memories are accessed without conscious awareness—they are automatically translated into actions without us even realizing it. As such, they can often be difficult to teach or explain to other people. Implicit memories differ from the semantic scripts described above in that they are usually actions that involve movement and motor coordination, whereas scripts tend to emphasize social norms or behaviors.

Working Memory from the Psychological

Since the concept of working memory was introduced over 50 years ago, different schools of thought have offered different definitions for working memory based on the various cognitive domains that it encompasses.

The general consensus regarding working memory supports the idea that working memory is extensively involved in goal-directed behaviors in which information must be retained and manipulated to ensure successful task execution. Before the emergence of other competing models, the concept of working memory was described by the multicomponent working memory model proposed by Baddeley and Hitch. In the present article, the authors provide an overview of several working memory-relevant studies in order to harmonize the findings of working memory from the neurosciences and psychological standpoints, especially after citing evidence from past studies of healthy, aging, diseased, and/or lesioned brains.

In particular, the theoretical framework behind working memory, in which the related domains that are considered to play a part in

different frameworks (such as memory's capacity limit and temporary storage) are presented and discussed.

From the neuroscience perspective, it has been established that working memory activates the fronto-parietal brain regions, including the prefrontal, cingulate, and parietal cortices. Recent studies have subsequently implicated the roles of subcortical regions (such as the midbrain and cerebellum) in working memory.

Aging also appears to have modulatory effects on working memory; age interactions with emotion, caffeine and hormones appear to affect working memory performances at the neurobiological level. Moreover, working memory deficits are apparent in older individuals, who are susceptible to cognitive deterioration. Another younger population with working memory impairment consists of those with mental, developmental, and/or neurological disorders such as major depressive disorder and others.

A less coherent and organized neural pattern has been consistently reported in these disadvantaged groups. Working memory of patients with traumatic brain injury was similarly affected and shown to have unusual neural activity (hyper- or hypoactivation) as a general observation. Decoding the underlying neural mechanisms of working memory helps support the current theoretical understandings concerning working memory, and at the same time provides insights into rehabilitation programs that target working memory impairments from neurophysiological or psychological aspects.

Working memory has fascinated scholars since its inception in the 1960's (Baddeley, 2010; D'Esposito and Postle, 2015). Indeed, more than a century of scientific studies revolving around memory in

the fields of psychology, biology, or neuroscience have not completely agreed upon a unified categorization of memory, especially in terms of its functions and mechanisms (Cowan, 2005, 2008; Baddeley, 2010).

From the coining of the term “memory” in the 1880’s by Hermann Ebbinghaus, to the distinction made between primary and secondary memory by William James in 1890, and to the now widely accepted and used categorizations of memory that include: short-term, long-term, and working memories, studies that have tried to decode and understand this abstract concept called memory have been extensive (Cowan, 2005, 2008).

Short and long-term memory suggest that the difference between the two lies in the period that the encoded information is retained. Other than that, long-term memory has been unanimously understood as a huge reserve of knowledge about past events, and its existence in a functioning human being is without dispute (Cowan, 2008). Further categorizations of long-term memory include several categories:

(1) episodic;

(2) semantic;

(3) Pavlovian; and

(4) procedural memory (Humphreys et al., 1989). For example, understanding and using language in reading and writing demonstrates long-term storage of semantics. Meanwhile, short-term memory was defined as temporarily accessible information that has a limited storage time (Cowan, 2008).

Holding a string of meaningless numbers in the mind for brief delays reflects this short-term component of memory.

Thus, the concept of working memory that shares similarities with short-term memory but attempts to address the oversimplification of short-term memory by introducing the role of information manipulation has emerged (Baddeley, 2012). This article seeks to present an up-to-date introductory overview of the realm of working memory by outlining several working memory studies from the psychological and neurosciences perspectives in an effort to refine and unite the scientific knowledge concerning working memory.

Episodic memory

Episodic memory refers to any events that can be reported from a person's life.

This covers information such as any times, places involved – for example, when you went to the zoo with a friend last week. It is a type of 'declarative' memory, i.e. it can be explicitly inspected and recalled consciously. Episodic memory can be split further into autobiographical episodic memory (memories of specific episodes of one's life) and experimental episodic memory (where learning a fact [a semantic memory, below] has been associated with memory of the specific life episode when it was learned). Flashbulb memories are detailed autobiographical episodic memories that are stored permanently in LTM when they are first learned, often because they were of emotional or historical importance in that person's life (e.g. a birth or a death).

Semantic memory

Like episodic memory, semantic memory is also a type of 'declarative' (explicit, consciously recalled) memory.

However, the conscious recall here is of facts that have meaning, as opposed to the recall of past life events associated with episodic memory. For instance, recalling that you listen to music using your ears does not require knowing when or where you first learned this fact.

Procedural memory

Procedural memory describes our implicit knowledge of tasks that usually do not require conscious recall to perform them. One example would be riding a bike –you might struggle to consciously recall how to manage the task, but we can [unconsciously] perform it with relative ease.

Theories of Forgetting: Interference, Retrieval Failure, Decay, Motivated forgetting

The Interference Theory

What did you have for dinner Tuesday night of last week? Is that difficult to recall? If someone had asked you that question Wednesday morning, you probably would have had no problem recalling what you had for dinner the night before.

But as intervening days pass, the memories of all the other meals you have eaten since then start to interfere with your memory of that one particular meal. This is a good example of what psychologists call the interference theory of forgetting.[4]

According to interference theory, forgetting is the result of different memories interfering with one another. The more similar two or more events are to one another, the more likely interference will occur.

It is difficult to remember what happened on an average school day two months ago because so many other days have occurred since then. Unique and distinctive events, however, are less likely to suffer from interference. Your high school graduation, wedding, and the birth of your first child are much more likely to be recalled because they are singular events—days like no other.

Interference also plays a role in what is known as the **serial position effect**, or the tendency to recall the first and last items of a list.[5] For example, imagine that you wrote down a shopping list but forgot to take it with you to the store. In all likelihood, you will probably be able to easily recall the first and last items on your list, but you might forget many of the items that were in the middle.

The first thing you wrote down and the last thing you wrote down stand out as being more distinct, while the fourth item and seventh item might seem so similar that they interfere with each other. There are two basic types of interference that can occur:[4]

- **Retroactive interference** happens when newly acquired information interferes with old memories. For example, a teacher learning the names of her new class of students at the start of a school year might find it more difficult to recall the names of the students in her class last year. The new information interferes with the old information.

- **Proactive interference** occurs when previously learned information makes it more difficult to form new memories. Learning a new phone number or locker combination might be more difficult, for example, because your memories of your old phone number and combination interfere with the new information.

Eliminating interference altogether is impossible, but there are a few things you can do to minimize its effects. One of the best things you can do is rehearse new information in order to better commit it to memory. In fact, many experts recommend overlearning important information, which involves rehearsing the material over and over again until it can be reproduced perfectly with no errors.[6]

Another tactic to fight interference is to switch up your routine and avoid studying similar material back to back. For example, don't try to study vocabulary terms for your Spanish language class right after studying terms for your German class. Break up the material and switch to a completely different subject each study session.

Sleep also plays an essential role in memory formation. Researchers suggest that sleeping after you learn something new is one of the best ways to turn new memories into lasting ones.

The Decay Theory of Forgetting

According to the trace theory of memory, physical and chemical changes in the brain results in a memory "trace." Information in short-term memory lasts several seconds and if it is not rehearsed, the neurochemical memory trace quickly fades.[8] According to the trace decay theory of forgetting, the events that

happen between the formation of a memory and the recall of the memory have no impact on recall.[9]

Trace theory proposes that the length of time between the memory and recalling that information determines whether the information will be retained or forgotten. If the time interval is short, more information will be recalled. If a longer period of time passes, more information will be forgotten and memory will be poorer.

The idea that memories fade over time is hardly new. The Greek philosopher Plato suggested such a thing more than 2,500 years ago. Later, experimental research by psychologists such as Ebbinghaus bolstered this theory.[2]

One of the problems with this theory is that it is difficult to demonstrate that time alone is responsible for declines in recall. In real-world situations, many things happen between the formation of a memory and the recall of that information. A student who learns something in class, for example, might have hundreds of unique and individual experiences between learning that information and having to recall it on an exam.

Was forgetting the date that the American Revolutionary War began due to the length of time between learning the date in your American History class and being tested on it? Or did the multitude of information acquired during that interval of time play a role? Testing this can be exceedingly difficult. It is nearly impossible to eliminate all the information that might have an influence on the creation of the memory and the recall of the memory.

Another problem with decay theory is it does not account for why some memories fade quickly while others linger. Novelty is one

factor that plays a role. For example, you are more likely to remember your very first day of college than all of the intervening days between it and graduation. That first day was new and exciting, but all the following days probably seem quite similar to each other.

Retrieval Failure Theory

Retrieval failure is where the information is in long term memory, but cannot be accessed. Such information is said to be available (i.e. it is still stored) but not accessible (i.e. it cannot be retrieved). It cannot be accessed because the retrieval cues are not present.

When we store a new memory we also store information about the situation and these are known as retrieval cues. When we come into the same situation again, these retrieval cues can trigger the memory of the situation. Retrieval cues can be:

External / Context - in the environment, e.g. smell, place etc.

Internal / State- inside of us, e.g. physical, emotional, mood, drunk etc.

There is considerable evidence that information is more likely to be retrieved from long-term memory if appropriate retrieval cues are present. This evidence comes from both laboratory experiments and everyday experience. A retrieval cue is a hint or clue that can help retrieval.

Tulving (1974) argued that information would be more readily retrieved if the cues present when the information was encoded were also present when its retrieval is required. For example, if you

proposed to your partner when a certain song was playing on the radio, you will be more likely to remember the details of the proposal when you hear the same song again. The song is a retrieval cue - it was present when the information was encoded and retrieved.

Tulving suggested that information about the physical surroundings (external context) and about the physical or psychological state of the learner (internal context) is stored at the same time as information is learned. Reinstating the state or context makes recall easier by providing relevant information, while retrieval failure occurs when appropriate cues are not present. For example, when we are in a different context (i.e. situation) or state.

Context (external) Cues

Retrieval cues may be based on context-the setting or situation in which information is encoded and retrieved. Examples include a particular room, driving along a motorway, a certain group of people, a rainy day and so on.

Context also refers to the way information is presented. For example, words may be printed, spoken or sung, they may be presented in meaningful groups - in categories such as lists of animals or furniture - or as a random collection without any link between them. Evidence indicates that retrieval is more likely when the context at encoding matches the context at retrieval.

You may have experienced the effect of context on memory if you have ever visited a place where you once lived (or an old school). Often such as visit helps people recall lots of experiences about the time they spent there which they did not realize were stored in their memory.

A number of experiments have indicated the importance of context-based cues for retrieval. An experiment conducted by **Tulving and Pearlstone (1966)** asked participants to learn lists of words belonging to different categories, for example names of animals, clothing and sports.

Participants were then asked to recall the words. Those who were given the category names recalled substantially more words than those who were not. The categories provided a context, and naming the categories provided retrieval cues. Tulving and Pearlstone argued that cue-dependent forgetting explains the difference between the two groups of participants. Those who recalled fewer words lacked appropriate retrieval cues.

An interesting experiment conducted by **Baddeley (1975)** indicates the importance of setting for retrieval. Baddeley (1975) asked deep-sea divers to memorize a list of words. One group did this on the beach and the other group underwater. When they were asked to remember the words half of the beach learners remained on the beach, the rest had to recall underwater.

Half of the underwater group remained there and the others had to recall on the beach. The results show that those who had recalled in the same environment (i.e. context) which that had learned recalled 40% more words than those recalling in a different environment. This suggests that the retrieval of information is improved if it occurs in the context in which it was learned.

State (internal) Dependent Cues

The basic idea behind state-dependent retrieval is that memory will be best when a person's physical or psychological state is similar at encoding and retrieval.

For example, if someone tells you a joke on Saturday night after a few drinks, you'll be more likely to remember it when you're in a similar state - at a later date after a few more drinks. Stone cold sober on Monday morning, you'll be more likely to forget the joke.

State retrieval clues may be based on state-the physical or psychological state of the person when information is encoded and retrieved. For example, a person may be alert, tired, happy, sad, drunk or sober when the information was encoded. They will be more likely to retrieve the information when they are in a similar state.

Tulving and Pearlstone's (1966) study involved **external cues** (e.g. presenting category names). However, cue-dependent forgetting has also been shown with **internal cues** (e.g. mood state). Information about current mood state is often stored in the memory trace, and there is more forgetting if the mood state at the time of retrieval is different. The notion that there should be less forgetting when the mood state at learning and at retrieval is the same is generally known as **mood-state-dependent memory**.

A study by **Goodwin et al. (1969)** investigated the effect of alcohol on state-dependent retrieval. They found that when people encoded information when drunk, they were more likely to recall it in the same state. For example, when they hid money and alcohol when drunk, they were unlikely to find them when sober. However, when they were drunk again, they often discovered the hiding place.

Other studies found similar state-dependent effects when participants were given drugs such as marijuana.

People tend to remember material better when there is a match between their mood at learning and at retrieval. The effects are stronger when the participants are in a positive mood than a negative mood. They are also greater when people try to remember events having personal relevance.

Evaluation

According to retrieval-failure theory, forgetting occurs when information is available in LTM but is not accessible. Accessibility depends in large part on retrieval cues. Forgetting is greatest when context and state are very different at encoding and retrieval. In this situation, retrieval cues are absent and the likely result is cue-dependent forgetting.

There is considerable evidence to support this theory of forgetting from laboratory experiments. The ecological validity of these experiments can be questioned, but their findings are supported by evidence from outside the laboratory.

For example, many people say they can't remember much about their childhood or their school days. But returning to the house in which they spent their childhood or attending a school reunion often provides retrieval cues which trigger a flood of memories.

Motivated Forgetting in Early

Educators assume that students are motivated to retain what they are taught. Yet, students commonly report that they forget most of

what they learn, especially in mathematics. In the current study I ask whether students may be motivated to forget mathematics because of academic experiences threaten the self-perceptions they are committed to maintaining. Using a large dataset of 1st and 2nd grade children (N = 812), I hypothesize that math anxiety creates negative experiences in the classroom that threaten children's positive math self-perceptions, which in turn spurs a motivation to forget mathematics.

I argue that this motivation to forget is activated during the winter break, which in turn reduces the extent to which children grow in achievement across the school year. Children were assessed for math self-perceptions, math anxiety and math achievement in the fall before going into winter break. During the spring, children's math achievement was measured once again.

A math achievement growth score was devised from a regression model of fall math achievement predicting spring achievement. Results show that children with higher math self-perceptions showed reduced growth in math achievement across the school year as a function of math anxiety. Children with lower math interest self-perceptions did not show this relationship. Results serve as a proof-of-concept for a scientific account of motivated forgetting within the context of education.

Introduction

Despite all of the effort that students put into studying, they commonly report that knowledge is rapidly lost once a course is over. While the belief in a total loss of formally acquired knowledge is false (Bahrick, 1979), it is true that students experience a significant amount of forgetting soon after the completion of a

course (Conway et al., 1991; Kamuche and Ledman, 2011). Research on long-term retention of classroom knowledge reports that forgetting arises because of blocked learning schedules (Landauer and Bjork, 1978; Dempster, 1992), a lack of subsequent relearning (Bahrick and Phelps, 1987; Bahrick and Hall, 1991; Cooper et al., 2000; Deslauriers and Wieman, 2011), poor initial knowledge structures and shallow levels of understanding gained during the course itself (Conway et al., 1991). In this article, I consider an alternative explanation. I draw on the suppression and threat based coping literature to argue that students themselves may be motivated to forget due to negative academic experiences that threaten their self-perceptions.

Motivated Forgetting

Motivated forgetting is the active process of forgetting memories that are unpleasant, painful, or generally threating to the self-image that individuals strive to maintain (Tajfel and Turner, 1986; Thompson et al., 1997). Research in cognitive psychology demonstrates that people can intentionally down-prioritize unwanted memories from entering consciousness via control processes. For instance, studies using the think-no-think paradigm (Anderson and Green, 2001; Anderson and Levy, 2009) demonstrate that individuals are capable of intentionally forgetting memories for words that were previously encoded. The think-no-think paradigm begins by requiring students to first learn a list of cue-target pairs (e.g., Ordeal-Roach). After this initial learning phase, individuals are presented with a previously studied cue (i.e., Ordeal) and are instructed to either remember the associated target word (i.e., Think of Roach) or to suppress the associated target word (i.e., No-think; Roach). During a memory test at the end, individuals are again

presented with the same cues and asked to try their best to recall the correct target memory words. These studies consistently reveal that individuals have more difficulty recalling words that they were previously instructed to suppress relative to words they were instructed to remember. Additionally, individuals are also worse at recalling suppressed words relative to baseline words which were previously studied but were not paired with either “remember” or “suppress” instructions.

Threat Based Model of Motivated Forgetting

The cognitive literature on intentional forgetting provides compelling evidence that forgetting previously encoded information is possible, yet it has not provided an account for why individuals engage in intentional forgetting outside of the laboratory. Recent social psychological investigations have advanced the motivated forgetting literature by developing a framework to predict the social and intrapersonal circumstances that elicit motivated forgetting.

A growing body of research draws on threat-based theories to argue that motivated forgetting arises as a possible coping mechanism to defend against memories that threaten the integrity of the self (Tajfel and Turner, 1986; Aronson et al., 1999; Sherman and Cohen, 2006). Threat-based theories begin with the premise that people are motivated to see themselves in an overly positive light and will fundamentally alter their behaviors, attention, and even memory processes to maintain this positive internal representation (Greenwald, 1980; Taylor and Brown, 1994).

Motivated Forgetting and Academic Break Periods

A recent study examined the consequences of motivated forgetting within the context of education, where students are generally motivated to remember. Ramirez et al. (2017) asked whether we can draw on the basic premises underlying the research on psychological threat and motivated forgetting to predict the circumstances under which students forget course content once the class is over. To test this, students enrolled in a multivariable calculus course were asked to report their math self-perceptions and course relevant stress. At the end of the quarter, students completed their final exam per usual which served as a baseline measure of acquired knowledge. The authors measured how much content students forgot by asking them to re-take some items from their final exam 2 weeks into the summer break.

Current Study

To summarize, memory research suggests that people are capable of intentional forgetting. Threat-based theories identify self-perceptions and experiences that threaten self-perceptions as key ingredients in creating a defensive memory reaction that leads to a motivation to forget. Recent neuro investigations of threat suggests that brain activity during rest periods is associated with activation in areas involved in defensive memory adaptations. The aim of the current proof-of-concept study is to address whether children at risk for motivated forgetting may be forgetting important course relevant content during academic break periods.

Limitations

The current study holds several limitations which warrant attention. For instance, the data collection timeline makes it difficult to make a strong case that the winter break period was responsible for

allowing students to engage in motivated forgetting; all of the students in the study underwent a winter break period. Future research should examine achievement immediately prior to and after the winter break period using assessments that measure what children are learning in their specific class. The reliability for my measure of math self-perceptions could have been higher if children had been presented with more items, as well. The correlational research design also did not allow me to manipulate extensive rest periods or identity threat, which could have provided causal evidence for the account I put forth. Lastly, I was also not able to assess perceived threat, intention to forget, or suppression-avoidance processes, which limited my ability to provide greater evidence for the mechanism of motivated forgetting.

Implications and Future Directions

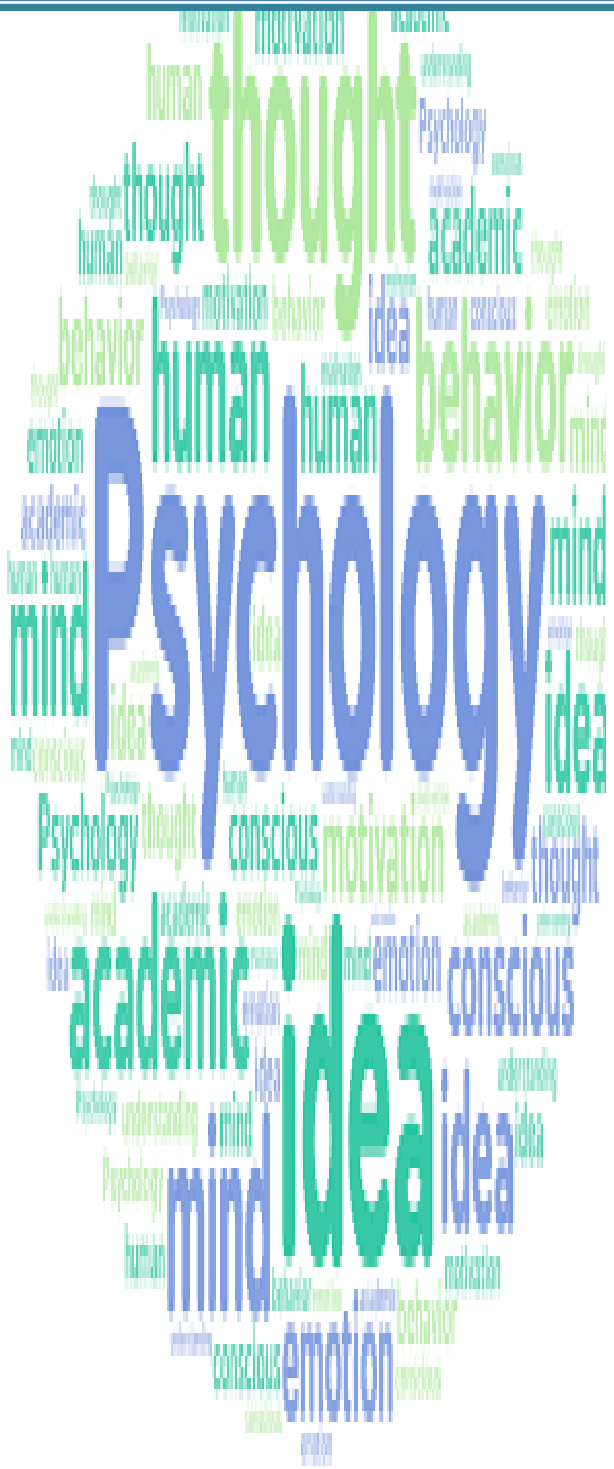
The work reported here extends research on motivated forgetting to an educational context where students typically exert a great deal of effort to avoid forgetting. This work also makes a novel contribution by providing evidence that even young children are capable of experiencing threat-based motivated forgetting. If motivated forgetting is indeed a factor reducing children's accessibility of memories for important course content, then ensuring that children begin and leave the classroom with a restored sense of self (Walton, 2014) could be quite useful in reducing motivated forgetting.

Conclusion

Taken together, the promising findings of this proof-of-concept study suggests that children may deal with threatening classroom experiences by forgetting important course relevant knowledge.

Although there has been a recent interest in using a motivated forgetting framework to understand defensive adaptations in the social psychology literature (Shu et al., 2011; Dalton and Huang, 2014; Kouchaki and Gino, 2016), the work reported here and elsewhere (Ramirez et al., 2017) is the first to extend research on motivated forgetting to the classroom. These findings lead to a novel conception of the defensive adaptations that students engage in when they are “at rest” from schooling.

UNIT-5 Attention, Perception, Learning, Memory and Forgetting MCQs



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UNIT-5 Attention, Perception, Learning, Memory and Forgetting MCQs 2020

1. When an object is moved farther away, we tend to see it as more or less invariant in size. This is due to:
(a) Shape Constancy
(b) Colour Constancy
(c) Size Constancy
(d) Brightness Constancy
(e) None of the above
Answer: C

2. Reversible goblet is a favourite demonstration of:
(a) A figure-ground reversal
(b) A focus-margin reversal
(c) A shape-size reversal
(d) A size-contour reversal
(e) None of the above
Answer: A

3. A simpler form of stroboscopic motion is :
(a) Psychokinesis
(b) Autokinetic Effect
(c) Phi-Phenomenon
(d) Illusion
(e) Hallucination
Answer: C

4. Empiricists (Barkeley, Locke) maintained that we learn our ways of perceiving through :
(a) Eyes
(b) Motivaton
(c) Experiene
(d) Learning
(e) None of the above
Answer: C

5. William James characterised the perception of an infant as a :
(a) Blooming buzzing confusion
(b) Haphazard Stimulation of nerve cells
(c) Stimulation of nerve cells in the eyes
(d) Stimulation of rods and cones
(e) None of the above
Answer: A

6. Behaviourists have:
(a) No theory of learning
(b) No theory of thinking
(c) No theory of memory
(d) No theory of perception
(e) None of the above
Answer: D

7. The process by which the eyes get prepared to see very dimlight is known as:
(a) Light Adaptation
(b) Dark Adaptation

(c) Brightness Adaptation
(d) Colour Adaptation
(e) None of the above
Answer: B

8. The partially colour blind people are known as:
(a) Blind
(b) Colour-blind
(c) Achromats
(d) Dichromats
(e) None of the above
Answer: D

9. Totally colour blind people are otherwise known as :
(a) Colour-blind
(b) Achromats
(c) Monochromats
(d) Dichromats
(e) None of the above
Answer: C

10. The phenomenon of sifting from one picture to another is known as :
(a) Retina Rivalry
(b) Eyes Rivalry
(c) Attention Rivalry
(d) Perception Rivalry
(e) None of the above
Answer: A

11. When the lens cannot bulge out to the extent necessary due to muscular defects, the individual suffers from:
(a) Double Vision
(b) Astigmatism
(c) Myopia
(d) Farsightedness
(e) None of the above
Answer: D

12. Due to the irregularities in the formation of the lens or the cornea, the object viewed will be partly clear and partly blurred. This occurs when the individual suffers from:
(a) Astigmatism
(b) Colour-blindness
(c) Distraction
(d) Ratinal Disparity
(e) None of the above
Answer: A

13. The length of car number has reference to:
(a) Shifting of Attention
(b) Distraction
(c) Span of Attention
(d) Focus and Margin
(e) Focus of Consciousness

Answer: C

14. Sensations of movement from inside our bodies are called:
(a) Proprioception
(b) Perception
(c) Interoception
(d) Sensation
(e) Attention
Answer: A

15. Sensation increases by a constant amount each time the stimulus is doubled. This is called:
(a) Lewin-Zeigamik Effect
(b) Lewin-Prentice Effect
(c) Mallinoswki Law
(d) Webber-Fechner Law
(e) None of the above
Answer: D

16. The experiments which tell us about the relationship between the intensity of stimulus and the consequent changes in the intensity of sensation are included in :
(a) Psychoanalysis
(b) Gestalt Psychology
(c) Parapsychology
(d) Psychophysics
(e) None of the above
Answer: D

17. The study on the Zulu tribes of Africa revealed that the Zulu individuals would be less susceptible to the:
(a) Figure-Ground Phenomenon
(b) Zollner Illusion
(c) Ponzo illusion
(d) Muller-Lyer Illusion
(e) None of the above
Answer: D

18. A complete change of vitreous humour occurs approximately once in:
(a) Every four hours
(b) Every three hours
(c) Every two hours
(d) Every one hour
(e) None of the above
Answer: A

19. The theory of colour perception which seems to be the most acceptable one today is called the:
(a) Retinex Theory
(b) Perspective Theory
(c) Confusion Theory
(d) Young-Helmholtz Theory
(e) None of the above

Answer: A

20. Who developed the 'Retinex Theory" of colour perception?
(a) Thomas Young
(b) Hermann Von Helmholtz
(c) Edward Herring
(d) Edwin Land
(e) None of the above
Answer: D

21. Who received Nobel Prize for his research on the mechanisms of the cochlea?
(a) Snyder
(b) Pronko
(c) VonBekesy
(d) Stratton
(e) Turnbull
Answer: C

22. The condition of night-blindness is a consequence of:
(a) Rhodopsin deficiency in rods
(b) Defective rods
(c) Defective Cones
(d) Defective Retina
(e) None of the above
Answer: A

23. As compared with cones, rods appear to be more sensitive to:
(a) Longer Wavelengths
(b) Any wavelengths
(c) Both shorter and longer wavelengths
(d) Shorter wavelengths
(e) None of the above
Answer: D

24. The alteration in the comparative sensitivity of the retinal apparatus which accompanies change in the level of light energy is known as:
(a) Purkinje Effect
(b) Dark Adaptation
(c) Scotopic Vision
(d) Visual Acuity
(e) None of the above
Answer: A

25. An increase in sensitivity of retina owing to absence of stimulation in darkness is known as:
(a) Dark Adaptation
(b) Scotopic Vision
(c) Visual Acuity
(d) Photopic Vision
(e) None of the above
Answer: A

26. The decrease in sensitivity of the eye which occurs on account of its stronger stimulation is known as:
(a) Light Adaptation
(b) Photopic Vision
(c) Scotopic Vision
(d) Visual Acuity
(e) None of the above
Answer: A

27. In cone adaptation experiment, test field is strictly limited to the:
(a) Cone-free fovea
(b) Cornea
(c) Retina
(d) Rod-free fovea
(e) None of the above
Answer: D

28. Reaction to powerful light, primarily by cones, is called:
(a) Photopic Vision
(b) Scotopic Vision
(c) Colourless Vision
(d) Visual Acuity
(e) None of the above
Answer: A

29. Visual reaction of the dark adapted eye to very feeble light is called :
(a) Photopic Vision
(b) Scotopic vision
(c) Visual Acuity
(d) Colourless Vision
(e) None of the above
Answer: B

30. Visual angle varies inversely with:
(a) Acuity
(b) Light
(c) Brightness
(d) Length of cones
(e) Length of rods
Answer: A

31. Ability to discriminate fine differences in visual detail or visual sharpness is otherwise known as:
(a) Photopic Vision
(b) Scotopic Vision
(c) Visual Acuity
(d) Colourless Vision
(e) None of the above
Answer: C

32. Intensity multiplied by its duration brings about a constant

perceptual effect. Let "I" stands for light intensity and "T" for time or duration, then IXT=C, where "C" is constant perceptual effectiveness. This above principle is called:
(a) Roscoe-Bunsen Law
(b) Hess and Polt Law
(c) Evans Principle
(d) Landis Principle
(e) None of the above
Answer: A

33. Cases of yellow-blue colour blindness are:
(a) Maximum
(b) Exceedingly Rare
(c) Mostly found in children
(d) Mostly found in women
(e) Mostly found in men
Answer: B

34. "Interest is latent attention and attention is interest in action." This statement deals with the:
(a) Objective determinants of attention
(b) Span of attention
(c) Subjective determinants of attention
(d) Shifting of attention
(e) None of the above
Answer: C

35. "It is not a different process; it is just attention to irrelevant stimuli that are not a part of the main assigned task." Then what is it?
(a) Distraction
(b) Shifting of Attention
(c) Span of attention
(d) Involuntary Attention
(e) Voluntary Attention
Answer: A

36. Simultaneous focussing on two separate activities is otherwise known as:
(a) Span of attention
(b) Shifting of attention
(c) Division of attention
(d) Distraction
(e) None of the above
Answer: C

37. When familiar large objects look smaller than they are known to be, they are regarded as being at a distance. This is an instance of what is called:
(a) Visual Acuity
(b) Monocular Parallax
(c) Linear Perspective

(d) Scotopic Vision
(e) Pliotopic Vision
Answer: C

38. Movement Parallax is a monocular cue of distance or depth and for this reason it is also called:
(a) Visual Acuity
(b) Monocular parallax
(c) Linear Perspective
(d) Scotopic vision
(e) Photopic Vision
Answer: B

39. Certain alterations in the colour of objects occur depending upon their relative distances from the observer. For this reason, distant hills look blue on account of the light rays travelling through haze. This illustrates:
(a) Linear Perspective
(b) Monocular Parallax
(c) Aerial Perspective
(d) Visual Acuity
(e) Scotopic Vision
Answer: C

40 A set of depth cues of the nature of some sort of arrangement of proportional rise and fall in compactness of de signs which is related to perspectives is called:
(a) Rods
(b) Cones
(c) Gradients
(d) Perspectives
(e) None of the above
Answer: C

41. The apparent displacement of an object resulting from an actual change of observer's position is known as:
(a) Parallax
(b) Acuity
(c) Scotopic Vision
(d) Photopic Vision
(e) None of the above
Answer: A

42. The phenomenon of "induced movement" occurs when there is some real movement which is attributed to:
(a) A right objects
(b) A real object
(c) A wrong object
(d) A substitute object
(e) None of the above
Answer: C

43. "It has been said that beauty is in the eye of the beholder"—With what factors of perception this statement deals?
(a) Objective Factors
(b) Figure and Ground
(c) Phi-phenomenon
(d) Functional Factors
(e) None of the above
Answer: D

44. According to Woodworth (1938), the first systematic experiment that attempted to measure the span of apprehension was carried out by:
(a) Jevons
(b) Paulham
(c) Jastrow
(d) Cairnes
(e) Hersey
Answer: A

45. The first experiment to measure span of attention (apprehension) was designed by:
(a) Coren and Porac in 1979
(b) Coren and Girgus in 1978
(c) Jevons in 1871
(d) Watkins in 1973
(e) None of the above
Answer: C

46. Who was/were the Subject (S) in Jevon's first experiment on span of apprehension?
(a) Boys from different SES
(b) Girls from different SES
(c) A friend of Jevons
(d) Jevons himself
(e) The wife of Jevons
Answer: D

47. The first person to document the existence of the sensory register and to explore its properties was:
(a) George Sperling (1960)
(b) Paulham (1887)
(c) Cairnes (1891)
(d) Hersey (1936)
(e) O'comer (1958)
Answer: A

48. From his experiments of sensory register, Sperling suggested that there is some visual trace available to the Subject that prolongs the life of the image. He calls this visual trace as the:
(a) Sensory Information Centre
(b) Perceptual Information Centre
(c) Attending Information Centre

(d) Apprehension Information Centre
(e) None of the above
Answer: A

49. In 1976, Neisser introduced a term for "Sensory Information Store." That term is called as:
(a) Focus
(b) Margin
(c) Prepotency
(d) Icon
(e) Extensity
Answer: D

50. When tachistoscope exposures are short and there is no post exposure masking field, we can be fairly sure that the Subject is actually reading the stimulus:
(a) From the icon rather than from the visual image itself
(b) From the image
(c) From the short-term memory storage
(d) From the long-term memory storage
(e) None of the above
Answer: A

51. A basis on which one stream of information can be segregated and attended to while others can be ignored is known as:
(a) Basilar Membrane
(b) Cochlea
(c) Tympanic Membrane
(d) Channel
(e) Eustachian tube
Answer: D

52. The most important school of psychology which has contributed a lot toward perception is:
(a) Psychoanalysis
(b) Behaviouristic School
(c) Structuralistic School
(d) Gestalt Psychology
(e) Functionalistic School
Answer: D

53. Autokinetic movement does not occur if there is a fixed:
(a) Frame of Reference
(b) Illusion
(c) Vision
(d) Distance between stimulus and the eye
(e) None of the above
Answer: A

54. A stimulus is any change in external energy that activates:
(a) An effector organ
(b) A sense organ and its receptors
(c) A cell
(d) A neuron
(e) Any cell of the sense organs
Answer: B

55. Hue, saturation and brightness are the conventional terms which are used to characterise the attributes of:
(a) Brightness
(b) Colours
(c) Light
(d) Darkness
(e) None of the above
Answer: B

56. Vision in the ordinary ranges of daylight from fairly faint twilight up to the brightest blaze of the sun is called:
(a) Photopic Vision
(b) Scotopic Vision
(c) Autokinetic Effect
(d) Phi-phenomenon
(e) Illusion
Answer: A

57. The important part of the inner ear for hearing is the snail-shaped:
(a) Cochlea
(b) Round Window
(c) Oval Window
(d) Semicircular Canals
(e) Auditory Nerve
Answer: A

58. The most primitive and oldest feature of music is:
(a) Harmony
(b) Melody
(c) Rhythm
(d) Song
(e) None of the above
Answer: C

59. Phi-phenomenon is a form of:
(a) Stroboscopic Motion
(b) Photopic Vision
(c) Scotopic Vision
(d) Autokinetic Effect
(e) Illusion
Answer: A

60. Which one of the following is not a principle of Organization of Perception?
(a) The Law of Proximity
(b) The Law of Similarity

(c) The Law of Pragnaz
(d) The Law of Contrast
(e) None of the above
Answer: D

61. Alcohol is/an:
(a) Stimulant
(b) Sensory Stimulus
(c) Effective Stimulus
(d) Depressant
(e) None of the above
Answer: D

62. The name given to the cone pigments is:
(a) Idopsin
(b) Bipolar Cells
(c) Ganglian Cells
(d) Rhodopsin
(e) None of the above
Answer: A

63. Ishihara test is meant for testing:
(a) Visual Experience
(b) Principal complementary Colour
(c) Wavelengths
(d) Colour-blindness
(e) None of the above
Answer: D

64. Young-Helmholtz theory of colour vision can otherwise be called:
(a) Trichromatic Theory
(b) Opponent Process Theory
(c) Ladd-Franklin Theory
(d) Scientific Validity Theory
(e) None of the above
Answer: A

65. A continuous small tremor of the eyes is known as:
(a) Rod-Cone breaks
(b) Purkinje Effect
(c) Physiological Nystagmus
(d) Acuity
(e) None of the above
Answer: C

66. The eye is sensitive to wavelengths of light that range from about:
(a) 380 to about 760 nm
(b) 300 to about 500 nm
(c) 200 to about 300 nm
(d) 160 to about 200 nm
(e) None of the above
Answer: A

67. Different wavelengths produce the experience of different:

(a) Colours
(b) Brightness
(c) Hues
(d) Lights
(e) None of the above
Answer: C

68. The Scottish Philosopher Thomas Reid (1710- 1796) has first developed the distinction between:
(a) Sensation and Attention
(b) Attention and Perception
(c) Audition and Vision
(d) Sensation and Perception
(e) Vision and Recurrent Inhibition
Answer: D

69. Helmholtz's theory of space perception centred around the concept of:
(a) Unconscious inference
(b) Conscious inference
(c) Recurrent Inhibition
(d) Mechanism of Vision
(e) The Static sense
Answer: A

70. RundolfLotze (1817-1881) assumed that mind is inherently capable of:
(a) Perceiving Space
(b) Perceiving Size
(c) Perceiving Depth
(d) Perceiving Colour
(e) Perceiving Brightness
Answer: A

71. Helmholtz's treatment of perception is the extension of:
(a) Herring's opponent-process theory
(b) Ladd-Franklin Theory
(c) Lotze's local-sign theory
(d) Recurrent inhibition theory
(e) None of the above
Answer: C

72. Who defined apperception as the awareness of any conscious content that is clearly comprehended or grasped?
(a) Ratliff
(b) E. B. Titchener
(c) J.B.Watson
(d) Wilmhelm Wundt
(e) Kurt Lewin
Answer: D

73. Harvey Carr defined perception as the cognition of a present object in relation to:
(a) Recurrent Inhibition

(b) Some acts of adjustment
(c) Some acts of stimulation
(d) Simultaneous Contrast
(e) None of the above
Answer: B

74. Gestalt Psychology looks upon the world as:
(a) Psychophysical
(b) Psychological
(c) Physical
(d) Neuro-physiological
(e) Neurological
Answer: A

75. Which principle states that because Gestalten are isomorphic to stimulus patterns, they may undergo extensive changes without losing their identities?
(a) Simultaneous Contrast
(b) Recurrent Inhibition
(c) Transposition
(d) Phi-phenomenon
(e) Autokinetic Effect
Answer: C

76. "Memory is a dynamic process in which traces undergo progressive changes according to some principles of organization that govern original perception."
This definition of memory was given by:
(a) Behaviourists
(b) Structuralists
(c) Functionalists
(d) Gestalt Psychologists
(e) Psychoanalysts
Answer: D

77. Who defined 'perception' as the process of maintaining contact with the world?
(a) Helmholtz
(b) Lorrin A. Riggs
(c) Herring
(d) Gibson
(e) None of the above
Answer: D

78. When the sense organs are oriented towards the environment and are actively seeking information, we call it—
(a) Obtained Perception
(b) Illusion
(c) Hallucination
(d) Attention
(e) Distraction
Answer: A

79. The perception which arises from the skin, nose, ears, eyes or other organs is called:
(a) Obtained Perception
(b) Illusion
(c) Hallucination
(d) Imposed Perception
(e) None of the above
Answer: D

80. The distinction between "Obtained and Imposed Perception" was brought out by:
(a) Helmholtz
(b) Herring
(c) Franklin
(d) Gibson
(e) Riggs
Answer: D

81. The gestalt concept of equilibrium is expressed by the law of:
(a) Similarity
(b) Proximity
(c) Continuity
(d) Pragnaz
(e) Good Figure
Answer: D

82. In 1915; Edgar Rubin introduced the idea of:
(a) Figure and Ground
(b) Phi-phenomenon
(c) Physiological Nystagmus
(d) Illusion
(e) Hallucination
Answer: A

83. The 'Law of Closure' reflects the idea of striving for:
(a) Goodflgure
(b) Continuity
(c) Completion
(d) Good Contour
(e) None of the above
Answer: C

84. Which law of organization in perception has become a principle of temporal contiguity in the learning theory?
(a) The Law of Similarity
(b) The Law of Pragnaz
(c) The Law of Proximity
(d) The La of Good Figure
(e) None of the above
Answer: C

85. The contrast between a dynamic field and a mechine was brought out by:
(a) KurtKoffka
(b) Wertheimer
(c) KurtLewin
(d) W. G. Kohler
(e) Helmholtz
Answer: D

86. The Gestalt Psychologists learned their "Principles of Organization" from the study of:
(a) Perception
(b) Sensory Experience
(c) Attention
(d) Consciousness
(e) Insightful Learning
Answer: B

87. Reinforcing factors in perceptual organization are analogous to the:
(a) Reinforcement of a conditioned response
(b) The Law of Effect
(c) Both (a) and (b)
(d) The Law of Exercise
(e) None of the above
Answer: C

88. Wavelength is obtained by dividing the speed of the light by the:
(a) Frequency
(b) Brightness
(c) Illumination
(d) Colour
(e) None of the above
Answer: A

89. For constancy to operate in the world of normal objects, the more distant features must be:
(a) Perceptually expanded
(b) Clearly Visualised
(c) Projected in sufficient light
(d) Clearly Spaced
(e) None of the above
Answer: A

90. Outline or boundary of an object is called:
(a) Contour
(b) Figure
(c) Ground
(d) Brightness
(e) None of the above
Answer: A

91. Prolongation or renewal of a sensory experience after the

stimulus has ceased to affect the sense organ is called:
(a) After image
(b) Illusion
(c) Hallucination
(d) Autokinetic Effect
(e) Stroboscopic Motion
Answer: A

92. A familiar study on perception which has shown that the poor children overestimated the size of coins to a greater degree than wealthy children, was done by:
(a) Bruner and Goodman
(b) Osgood
(c) Dember
(d) Murray
(e) Mc Ginnis
Answer: A

93. Camouflage is the deliberate confusion of:
(a) Illusion and Hallucination
(b) Stroboscopic Motion
(c) Figure and Ground
(d) Autokinetic Effect
(e) Phi-phenomenon
Answer: C

94. The protective colouration of many animals is an example of:
(a) Figure and Ground
(b) Camouflage
(c) Reversible Figures
(d) Phi-phenomenon
(e) Autokinetic Effect
Answer:B

95. Sense Organs in the muscles, tendons and joints tell us about the position of our limbs and the state of tension in the muscles. They serve the sense called:
(a) Kinesthesis
(b) Transduction
(c) Vision
(d) Auditory Sense
(e) None of the above
Answer: A

96. The process of converting physical energy into nervous system activity is called:
(a) Transmission
(b) Nerve Impluse
(c) Inhibition
(d) Transduction
(e) None of the above
Answer: D

97. Receptor cells convert physical energy into an electric voltage or potential called:
(a) Receptor Potential
(b) Generator Potential
(c) Vestibular Sense
(d) Spike Potential
(e) None of the above
Answer: A

98. Whether it is the receptor potential itself or some other voltage, the electrical event that triggers nerve impulses is known as the:
(a) Spike Potential
(b) Generator Potential
(c) Receptor Potential
(d) Nerve Impulse
(e) None of the above
Answer: B

99 The entire range of wavelengths is called the:
(a) Electromagnetic Spectrum
(b) Visible Spectrum
(c) Photosensitive Area
(d) Blind Spot
(e) None of the above
Answer: A

100. The tendency to perceive a line that starts in one way as continuing in the same way is called the principle of:
(a) Proximity
(b) Similarity
(c) Closure
(d) Continuation
(e) None of the above
Answer: D

101. The idea that we may be 'ready' and 'primed for' certain kinds of sensory input is known as:
(a) Set
(b) Cognitive Style
(c) Sensory System
(d) Mood
(e) None of the above
Answer: A

102. The spatial-frequency theory maintains that form vision depends on the firing pattern of brain cells that respond to variations in the rates of change in brightness from:
(a) One part of a visual scene to another
(b) Temporal lobe to Frontal lobe
(c) One part of the brain to another
(d) Spinal cord to brain

(e) None of the above
Answer: A

103. The receptors for taste are specialized cells grouped together in little clusters known as:
(a) Tongue
(b) Taste Buds
(c) Taste Nerves
(d) Sweet Glands
(e) None of the above
Answer: B

104. The audible range for human beings is from about:
(a) 20 hertz to about 20,000 hertz
(b) 200 hertz to about 2000 hertz
(c) 400 hertz to about 4000 hertz
(d) 300 hertz to about 3000 hertz
(e) 600 hertz to about 6000 hertz
Answer: A

105. On a dark night, we may hear the footsteps of a thief outside the house, where as in reality, a cat may be passing by. This is an example of:
(a) Hallucination
(b) Illusion
(c) Linear perspective
(d) Law of Pragnaz
(e) None of the above
Answer: B

106. In a study on the Zulu tribes of Africa, the Experimenters reasoned that the Zulu individuals would be less susceptible to the Muller- Lyer illusion than the European people in Africa. This illustration states that:
(a) Perception of illusions depends on the culture of the perceiver
(b) Perception of illusion depends on the Socio-economic Status
(c) Perception of illusions depends on the educational qualification of the individuals
(d) Perception of illusion depends on the colour of the individuals
(e) None of the above
Answer: A

107. Sometimes it is very difficult to find an empty seat in a dark cinema hall. We bump against people and sometimes try to sit on them after entering to the dark hail in a sunny afternoon. After a brief span of time, we may adapt to darkness and see. This is an example of:
(a) Dark Adaptation
(b) Perceptual Constancy
(c) Depth Perception

(d) Brightness Constancy
(e) Colour Constancy
Answer: A

108. One psychologist has developed a theory of colour vision as well as a theory of hearing. Who is he?
(a) Von Bekesy
(b) Helmholtz
(c) Hubel
(d) Wiesel
(e) N.R. Carlson
Answer: B

109. From the following, who won the Nobel Prize for his research on the mechanisms of the cochlea?
(a) Helmholtz
(b) Von Bekesy
(c) E. Gardner
(d) Schiffman
(e) Leiman
Answer: B

110. When your friend is at a distance, certainly he looks smaller than when he is standing close to you. But you do not think that really he is smaller or shorter. The size of familiar objects does not change with distance. As your friend comes closer to you from a distance, you do not think that he is getting larger and larger. This is an illustration of:
(a) Size Constancy
(b) Object Constancy
(c) Height Constancy
(d) Depth Constancy
(e) Binocular Vision
Answer: A

111. The mechanism of reflex action is called:
(a) Reflexology
(b) Reflex Path
(c) Reflex Arc
(d) Reflexon
(e) None of the above
Answer: C

112. Figure-ground relationship was first established by:
(a) Gestalt Psychologists
(b) Behaviourists
(c) Structuralists
(d) Functionalists
(e) None of the above
Answer: A

113. Closure is a basic principle of:
(a) Perceptual defence
(b) Perceptual Organization

(c) Depth Perception
(d) Phi-phenomenon
(e) None of the above
Answer: B

114. Personal factors in perception are otherwise known as:
(a) Functional factors in perception
(b) Motivational factors in perception
(c) Social factors in perception
(d) Cultural factors in perception
(e) None of the above
Answer: A

115. The gap between Cornea and lens is filled with:
(a) Amino Acid
(b) Vitreous Humour
(c) Unknown Fluid
(d) Aqueous Humour
(e) None of the above
Answer: D

116. The image of an object falling on the blind spot of the eye :
(a) Will be visible
(b) Will not be visible
(c) Automatically vanishes
(d) Is not clear
(e) None of the above
Answer: B

117. The gap between cornea and lens is known as:
(a) Posterior Chamber
(b) Anterior Chamber
(c) Inner Chamber
(d) Secular Chamber
(e)None of the above
Answer: B

118. The innermost layer of the eye is called:
(a) Cornea
(b) Retina
(c) Blind Spot
(d) Fovea
(e) None of the above
Answer: B

119. The point at which the optic nerve gets out of the retina is called the:
(a) Light Spot
(b) Fovea
(c) Blind Spot
(d) Yellow Spot
(e) None of the above
Answer: C

120. A person who has no cones at the fovea:
(a) Is a colour blind
(b) Is very often a colour blind
(c) Is not able to see yellow colour at all
(d) Is deprived of black and white vision
(e)
None of the above
Answer: A

121. Perception without sensory stimulus is called:
(a) Illusion
(b) Phi-phenomenon
(c) Hallucination
(d) Perceptual Defence
(e) Perceptual Constancy
Answer: C

122. As the eyes become adapted to dark at one particular point, red colours begin to darken and the green and blues become brighter. This change is known as:
(a) Duplicity theory of Colour Vision
(b) Herring's theory of Colour Vision
(c) Purkinje Effect
(d) Perceptual Constancy
(e) None of the above
Answer: C

123. The classic example of perceiving a coil of rope in darkness as a snake depicts about:
(a) Hallucination
(b) Illusion
(c) Phi-phenomenon
(d) Autokinetic Effect
(e) Perceptual Constancy
Answer: B

124. Meaningful sensation is otherwise known as:
(a) Attention
(b) Sensation
(c) Emotion
(d) Perception
(e) None of the above
Answer: D

125. Size judgement is based on:
(a) Retinal Image
(b) Clarity of Object
(c) Object Size
(d) Distance Information
(e) None of the above
Answer: D

126. "Perceived Size" approaches "physical size" when:

(a) Depth and Distance Cues are available
(b) Object is small
(c) Information is Minimum
(d) Object is Old
(e) None of the above
Answer: A

127. Which one of the following happens to be an important factor in selectivity of attention?
(a) Attitude
(b) Interest
(c) Boredom
(d) Concentration
(e) None of the above
Answer: B

128. An incorrect interpretation of the stimulus input is called:
(a) Illusion
(b) Hallucination
(c) Sensation
(d) Perception
(e) Attention
Answer: A

129. Each receptor requires some minimum level of energy to excite it. That minimum energy is called:
(a) Minimum Threshold
(b) Absolute Threshold
(c) Boundary Threshold
(d) Contour Threshold
(e) None of the above
Answer: B

130. A general principle of perception of form is the law of Pragnaz which was termed by:
(a) Behaviourists
(b) Structuralists
(c) Functionalists
(d) Gestalt Psychologists
(e) None of the above
Answer: D

131. Which one of the following is a stimulus variable in the determination of attending?
(a) Interest
(b) Attitude
(c) Size
(d) Aptitude
(e) None of the above
Answer: C

132. The perception of the whiteness of the snow even though the night dark can be explained on the basis of:
(a) Purkinje Effect

(b) Dark Adaptation
(c) Brightness Constancy
(d) Perceptual Defence
(e) None of the above
Answer: C

133. Perception of "Figure and Ground" results from:
(a) Experience
(b) Sensation Pattern
(c) Trial and Error
(d) The structure of Nervous System
(e) None of the above
Answer: B

134. An one-eyed person would lose precision in the perception of:
(a) Height
(b) Weight
(c) Colour
(d) Depth
(e) None of the above
Answer: D

135. The perceptual principle of 'proximity' states that:
(a) When stimuli are close together they tend to be grouped
(b) The nearer an object is, the more likely it is to be perceived
(c) The closer a stimulus is, the more likely it is to be attended
(d) Stimuli coming from equal distance are perceived as part of the same figure
(e) None of the above
Answer: A

136. Even though parallel, the rails appear to be meeting at a distance. This is a bright illustration of:
(a) Linear Perspective
(b) Distance Perception
(c) Visual Illusion
(d) Aerial perspective
(e) None of the above
Answer: C

137. In a normal waking state, if an individual gets certain sensation with particular stimulus which is not available to others, this person is said to have:
(a) An illusion
(b) A phi-phenomenon
(c) A sensation
(d) A hallucination
(e) None of the above
Answer: D

138. Figure and Ground perception results from:
(a) Attention Pattern
(b) Sensation pattern
(c) Perception Pattern
(d) Emotional pattern
(e) None of the above
Answer: B

139. Perception is a:
(a) Psychological Process
(b) Physiological Process
(c) Physical Process
(d) Psycho-physiological Process
(e) None of the above
Answer: D

140. We perceive a square as a square in whatever position it is held, this constancy in perception relates to:
(a) Size
(b) Depth
(c) Shape
(d) Height
(e) Weight
Answer: C

141. Illusion is the:
(a) False perception
(b) Right perception
(c) Wrong perception
(d) Delayed Perception
(e) None of the above
Answer: C

142. Hallucinations occur to individuals suffering from:
(a) Hysteria
(b) Epilepsy
(c) Peptic Ulcer
(d) Schizophrenia
(e) Asthma
Answer: D

143. A normal individual may experience hallucinations after taking drugs like:
(a) Heroin
(b) Morphine
(c) Seconel
(d) Pethedine
(e) None of the above
Answer: A

144. The tendency to see the immobility of objects when he moves about is called:
(a) Location Constancy
(b) Size Constancy
(c) Shape Constancy
(d) Depth Constancy

(e) None of the above
Answer: A

145. A contour is the boundary between:
(a) A figure and its ground
(b) A figure and another figure's ground
(c) Two similar figures
(d) Two dissimilar figures
(e) None of the above
Answer: A

146. An object that has been constituted perceptually as a permanent and stable thing continue to be perceived as such, regardless of illumination, position, distance etc. This kind of stability of the environment experienced by human beings is termed as:
(a) Depth Constancy
(b) Perceptual Constancy
(c) Size Constancy
(d) Shape constancy
(e) None of the above
Answer: B

147. Whenever an object appears to maintain its shape despite marked changes in the retinal image, it is known as:
(a) Size Constancy
(b) Depth Constancy
(c) Shape Constancy
(d) Height Constancy
(e) None of the above
Answer: C

148. A red ball looks red in broad daylight as well as in dark night. This is due to:
(a) Light Constancy
(b) Brightness Constancy
(c) Size Constancy
(d) Colour Constancy
(e) None of the above
Answer: A

149. Soldiers dressed in colours of uniform that merge with the background is called:
(a) Colour Matching
(b) Colour Constancy
(c) Brightness Constancy
(d) Camaouflage
(e) None of the above
Answer: D

150. When there is a deliberate confusion of figure and ground and it

is difficult to organise form and distinguish objects from one another, it is called:
(a) Camaouflage
(b) Phi-phenomenon
(c) Colour Constancy
(d) Brightness Constancy
(e) None of the above
Answer: A

151. Which principle/law of organization in perception states that there is a tendency to organize stimuli to make a balanced or sym-metrical figure that includes all parts?
(a) Law of Similarity
(b) Law of Symmetry
(c) Law of Proximity
(d) Law of Closure
(e) Law of Pragnaz
Answer: B

152. Stimuli that make the lowest interruptions in contour also tend to be grouped together. The tendency to organize the fragmentary stimuli into a familiar pattern is called the principle of:
(a) Similarity
(b) Proximity
(c) Closure
(d) Continuation
(e) Pragnaz
Answer: D

153. "Why do things look the way they do"? —This question was asked by the Gestalt Psychologist:
(a) W. G. Kohler
(b) M. Wertheimer
(c) Kurt Lewin
(d) K. Koffka
(e) None of the above
Answer: D

154. An illusion is not a trick or misperception. It is a/an:
(a) Attention
(b) Sensation
(c) Perception
(d) Emotion
(e) Motive
Answer: C

155. "The whole (perception) is more than the sum of its parts (Sensory inputs)". This statement was given by:
(a) Behaviourists
(b) Gestalt Psychologists
(c) Functionalists

(d) Psychoanalysts
(e) Structuralists
Answer: B

156. The events, we perceive clearly, are at the:
(a) Margin
(b) Centre
(c) Side
(d) Focus
(e) None of the above
Answer: D

157. Attention is the term given to the processes that select certain inputs for inclusion in the focus of:
(a) Sensation
(b) Consciousness
(c) Unconsiousness
(d) Experience
(e) None of the above
Answer: B

158. The most fundamental process in form perception is the recognition of:
(a) A figure on a ground
(b) A picture without background
(c) A figure without ground
(d) The contour of a figure
(e) None of the above
Answer: A

159. Which principle of perceptual organization makes our perceived world of form more complete than the sensory stimulation that is presented?
(a) The Law of Pragnaz
(b) The Law of Closure
(c) The Law of Similarity
(d) The Law of Proximity
(e) The Law of Continuity
Answer: B

160. The device which is used in perceptual experiments for the very brief presentation of stimuli is known as:
(a) Psycho galvanometer
(b) Tachistoscope
(c) Aesthesiometer
(d) Electroencephalograph
(e) Polygraph
Answer: B

161. Coal looks black even in very bright sunlight, while snow continues to look white even at night. This is due to:
(a) Colour Constancy
(b) Size Constancy

(c) Shape Constancy
(d) Constancy of Brightness
(e) Colour Reflection
Answer: D

162. Monocular Cues are those which can operate when:
(a) Two eyes are looking
(b) Both eyes are invalid
(c) Only one eye is looking
(d) Only one eye is invalid
(e) None of the above
Answer: C

163. A gradient is a continuous change:
(a) Without abrupt transitions
(b) With abrupt transitions
(c) With highest stimulating agent
(d) With lowest stimulating agent
(e) None of the above
Answer: A

164. Retinal disparity is the difference in the images falling on:
(a) The retinas of the two eyes
(b) The foveas of the two eyes
(c) The blind spots of the two eyes
(d) The corneas of the two eyes
(e) None of the above
Answer: A

165. Who conducted a pioneering experiment to show that "Value" has a considerable effect on perception?
(a) Bruner and Goodman
(b) Osgood
(c) Dember
(d) Carter
(e) Postman
Answer: A

166. Which one of the following is a term given to the processes that select certain inputs for inclusion in the focus of experience?
(a) Sensation
(b) Emotion
(c) Affection
(d) Attention
(e) Conation
Answer: D

167. Which are the well known examples of the transformations and elaborations of sensory input that occur in the process of perceiving the world?
(a) Hallucinations
(b) Sensations
(c) Illusions

(d) Conation
(e) Attention
Answer: C

168. Who has first pointed out that the 'Whole' is more than the sum total of its parts?
(a) Kohler
(b) Wertheimer
(c) KurtLewin
(d) KurtKoffka
(e) Otto Rank
Answer: D

169. Which one of the following is formed whenever a marked difference occurs in the brightness or colour of the background?
(a) Sizes
(b) Shapes
(c) Contours
(d) Sets
(e) None of the above
Answer: C

170. Perceived motion also occurs without any energy movement across the receptor surface. This type of motion is called:
(a) Constant Motion
(b) Retinal Disparity
(c) Real motion
(d) Apparent Motion
(e) None of the above
Answer: D

171. Which one of the following is an increase in the activity to extract information from the environment as a result of experience or practice with the stimulation coming from it?
(a) Convergence
(b) Divergence
(c) Perceptual Learning
(d) Plasticity of Perception
(e) None of the above
Answer: C

172. The ability to read other people's thoughts is called
(a) Prerecognition
(b) Telepathy
(c) Psychokinesis
(d) Clairvoyance
(e) None of the above
Answer: B

173. "We perceive things as we are". This statement emphasises upon:
(a) Functional Factors in Perception
(b) Objective Patterns in Perception

(c) Organizational factors in perception
(d) Voluntary Attention
(e) Involuntary Attention
Answer: A

174. The fact that the moon looks larger near the horizon than high in the sky is called the:
(a) MullerLyer Illusion
(b) Jastrow Illusion
(c) Ponzo illusion
(d) Moon Illusion
(e) Height-Width Illusion
Answer: D

175. One of the causes of the mental set is:
(a) Mood
(b) Emotion
(c) Sensation
(d) Habit
(e) Span
Answer: D

176. The old saying "Seeing is believing" does not hold good in case of:
(a) Hallucination
(b) Illusion
(c) Affection
(d) Conation
(e) Stimulation
Answer: B

177. The stimulus is explicit in:
(a) Hallucination
(b) Illusion
(c) Affection
(d) Conation
(e) Stimulation
Answer: B

178. In illusion, the stimulation is usually external, while the stimulations in hallucinations are:
(a) In the person himself
(b) In the stimulus itself
(c) Both in stimulus and perceiver
(d) In the external world
(e) None of the above
Answer: A

179. Muller-Lyer illusion is:
(a) Also a hallucination Jastrow illusion
(b) An individual illusion
(c) Otherwise called as
(d) An optical illusion
(e) None of the above
Answer: D

180. We are able to separate forms from the general ground in our visual perception only because we can perceive:
(a) Size
(b) Shape
(c) Side
(d) Contours
(e) Colours
Answer: D

181. The thought perception without any known means of communication is known as:
(a) Preognition
(b) Psychokinesis (PK)
(c) Clairovoyance
(d) Telepathy
(e) None of the above
Answer: D

182. The perception of future events or happenings through dreams or hallucinations is known as:
(a) Psychokinesis (PK)
(b) Clairovoyance
(c) Precognition
(d) Telepathy
(e) None of the above
Answer: C

183. Attention divides our perceived world into:
(a) Focus and Margin
(b) Margin and Centre
(c) Nucleus and Focus
(d) Focus and centre
(e) None of the above
Answer: A

184. The tendency to see the colour of a familiar object as the same, regardless of the actual light conditions is called:
(a) Colour Constancy
(b) Brightness Constancy
(c) Light Constancy
(d) Dark Constancy
(e) None of the above
Answer: A

185. By comparing experimental outcomes, which model provides more accurate predictions?
(a) Averaging Model
(b) Additive Model
(c) Self-attribution Model
(d) Personal-attribution Model
(e) None of the above
Answer: A

186. Experimental evidences suggest that people use a weighted averaging model to combine:
(a) Type information
(b) Attribute information
(c) Non-common Effects
(d) Trait information
(e) None of the above
Answer: D

187. The way in which individuals focus on specific traits to form an overall impression of others is known as:
(a) Social perception
(b) Perceptual organization
(c) Person Perception
(d) Phi-phenomenon
(e) Perceptual Constancy
Answer: C

188. Averaging models suggest that the mean of the information is:
(a) Most appropriate
(b) Not most appropriate
(c) Predictable
(d) Unpredictable
(e) None of the above
Answer: A

189. "Schemas" are organized bodies of information stored in:
(a) Perceptual Field
(b) Cognitive Field
(c) Emotion field
(d) Memory
(e) Sensation
Answer: D

190. In case of personality traits, we organize information into schemas called:
(a) Common Effects
(b) Non-common Effects
(c) Prototypes
(d) Somatotypes
(e) Stereotypes
Answer: C

191. Prototypes are schemas that organize a group of personality traits into a/an:
(a) Meaningful Personality Type
(b) Meaningless Personality Type
(c) Emotional Trauma
(d) Avoidance conflicting situation
(e) None of the above
Answer: A

192. The personality types that we derive in the case of person

perception are organized into schemas known as:
(a) Prototypes
(b) Stereotypes
(c) Somatotypes
(d) Phi-phenomenon
(e) None of the above
Answer: A

193. Nancy Cantor and Walter Mischel suggest a frequently held prototypes concerns a person labelled on a general level as:
(a) "Permitted"
(b) "Submitted"
(c) "Dedicated"
(d) "Committed"
(e) None of the above
Answer: D

194. At what level, the prototype consists of different types of committed individuals like monks, nuns and activists?
(a) Personal Level
(b) Environmental Level
(c) Subordinate Level
(d) Secondary Level
(e) Primary Level
Answer: C

195. Information processing capabilities are enhanced through the use of:
(a) Stereotypes
(b) Prototypes
(c) Prejudices
(d) Attitudes
(e) None of the above
Answer: B

196. With any schema, prototypes help us to organize:
(a) The social world around us
(b) The psychological world around us
(c) The psychophysical world around us
(d) The physical world around us
(e) None of the above
Answer: A

197. Covariation principle suggests that we try to analyse the relationships among a multitude of possible cause-and-effect variables inherent in a situation:
(a) To pin point a cause of behaviour
(b) To find out the cause of perceptual errors
(c) To find out cause of sensational errors

(d) To find out the cause of social perception
(e) None of the above
Answer: A

198. The Covariation Principle" states that the cause that will be choosen to explain an effect a cause that is present when the effect is also absent. This principle was introduced by:
(a) T. D. Wilson
(b) Keith Davis
(c) Harold Kelley
(d) E.E. Jones
(e) I.J. Stone
Answer: C

199. Consensus is the degree to which other people react similarly in the:
(a) Same situation
(b) Different situation
(c) Different emotional setup
(d) Different sensational setup
(e) None of the above
Answer: A

200. Consistency refers to the degree to which the actor behaves the same way in :
(a) Different situations
(b) Similar situations
(c) Both similar and dissimilar situations
(d) Other situations
(e) None of the above
Answer: D

201. "A goal refers to some substance, objects or environmental condition capable of reducing or temporarily eliminating the complex of internal conditions which initiated action." This definition of "goal" was given by:
(a) Janis& Mann (1977)
(b) Ruch (1970)
(c) Solomon and Corbit (1974)
(d) Neal Miller (1959)
(e) None of the above
Answer: B

202. Cannon called the concept of internal equilibrium and function as:
(a) Imprinting
(b) Instinct
(c) Homeostasis
(d) Substitute Behaviour
(e) None of the above
Answer: C

203. The expectations or goal that one sets to achieve in future keeping in view his past performance is called:
(a) Valence
(b) Vector
(c) Vigilance
(d) Level of Aspiration
(e) None of the above
Answer: D

204. "The need for achievement" was first defined largely on the basis of clinical studies done by:
(a) Murray (1938)
(b) Janis and Mann (1977)
(c) Solomon (1974)
(d) Corbit (1974)
(e) None of the above
Answer: A

205. The achievement motivation theory of Mc Clelland is explained in terms of:
(a) "Affective Arousal model of motivation"
(b) Action Specific energy
(c) Innate Releasing Mechanism
(d) Displacement Behaviour
(e) Opponent Process Theory
Answer: A

206. Intrinsic Motivational Theory was propounded by:
(a) Mc Clelland
(b) Maslow
(c) Harry Harlow
(d) Solomon
(e) Corbit
Answer: C

207. Psychoanalytic theory of motivation was developed by:
(a) Sigmund Freud
(b) Maslow
(c) Harry Harlow
(d) McClelland
(e) None of the above
Answer: A

208. The goals which the person tries to escape are called:
(a) Positive goals
(b) Vectors
(c) Valences
(d) Negative goals
(e) None of the above
Answer: D

209. A person's need for feeling competent and self-determining in

dealing with his environment is called:
(a) Intrinsic Motivation
(b) Instinct
(c) Imprinting
(d) Coolidge Effect
(e) None of the above
Answer: A

210. When the motive is directed towards goals external to the person such as money or grade, it is called:
(a) Extrinsic Motivation
(b) Intrinsic Motivation
(c) Imprinting
(d) Instinct
(e) None of the above
Answer: A

211. Steers and Porter (1975) in their text entitled "Motivation and work behaviour" identified:
(a) Two major components of motivation
(b) Four major components of motivation
(c) Five major components of motivation
(d) Three major components of motivation
(e) None of the above
Answer: D

212. The conditions which influence the arousal, direction and maintenance of behaviours relevant in work settings are called:
(a) Work Motivation
(b) Drive stimuli
(c) Substitute behaviour
(d) Consummatory behaviour
(e) None of the above
Answer: A

213. Intrinsic motivation as currently conceived is championed by:
(a) Janis (1977)
(b) Soloman (1974)
(c) Deci (1975)
(d) Mann (1977)
(e) Corbit (1974)
Answer: C

214. Most of the research on intrinsic motivation has concentrated on the interaction between:
(a) Intrinsic and extrinsic rewards
(b) Instinct and imprinting
(c) Action specific energy and balance sheet grid

(d) Substitute behaviour and consummatory behaviour
(e) None of the above
Answer: A

215. An individual's affective orientation towards particular outcomes is called the:
(a) Vector of the outcome
(b) Approach gradient of the outcome
(c) Valence of the outcome
(d) Avoidance gradient of the outcome
(e) None of the above
Answer: C

216. Dipboye (1977) distinguished between the strong and weak version of:
(a) Achievement theory
(b) Two-factor theory
(c) Valence theory
(d) Consistency theory
(e) None of the above
Answer: D

217. Motives are:
(a) Internal sources of behaviour
(b) External sources of behaviour
(c) Natural sources of behaviour
(d) Both subjective and objective sources of behaviour
(e) None of the above
Answer: A

218. Motives move a person from:
(a) Within
(b) Outside
(c) Beginning
(d) Birth
(e) Death
Answer: A

219. Literally, motivation means the process of inducing:
(a) Movement
(b) Excitement
(c) Tension
(d) Conflict
(e) None of the above
Answer: A

220. Motivation is defined as a state of the organism in which bodily energy is mobilised and selectively directed towards parts of the:
(a) Stimulus
(b) Response
(c) World
(d) Environment
(e) None of the above

Answer: D

221. "Mobilisation of bodily energy" is otherwise known as:
(a) Drive
(b) Need
(c) Motive
(d) Incentive
(e) None of the above
Answer: A

222. The selected part of environment refers to the end results of behaviour sequence which are known as:
(a) Aims
(b) Objectives
(c) Goals
(d) Destinations
(e) None of the above
Answer: C

223. Goal refers to:
(a) Directional aspects of behaviour
(b) End result of instrumental behaviour
(c) Destination after conscious activities
(d) Occasional halts
(e) None of the above
Answer: A

224. When a motive is aroused and the organism is driven to a goal, a condition is produced within the organism called:
(a) Conflict
(b) Tension
(c) Anxiety
(d) Jealousy
(e) None of the above
Answer: B

225. The tension increases when the goal is:
(a) Free
(b) Easy to achieve
(c) Obstructed
(d) Static
(e) None of the above
Answer: C

226. Those internal mechanisms of the body which, by controlling numerous highly complicated physiological processes, keep it in a state of equilibrium are known as:
(a) Homeostases
(b) Nervous System
(c) Nutrition
(d) None of the above
Answer: A

227. Homeostasis is the overall term for equilibrium preserving tendencies with an organism by which:
(a) Neurophysiological condition is maintained
(b) Psychological condition is maintained
(c) Physiological condition is maintained
(d) Psychophysical condition is maintained
(e) None of the above
Answer: A

228. Curiosity comes under:
(a) Social Motives
(b) Personal motives
(c) Non-homeostatic motives
(d) Both (b) and (c)
(e) None of the above
Answer: B

229. Sex is a:
(a) Biological motive
(b) Physiological motive
(c) Both (a) and (b)
(d) Psychological motive
(e) None of the above
Answer: C

230. Maslow's idea about the structure of needs is known as:
(a) Self-actualisation theory of motivation
(b) Physiological theory of motivation
(c) Psychological theory of motivation
(d) Psychophysical theory of motivation
(e) None of the above
Answer: A

231. "Intrinsic motivation theory" was developed by:
(a) Halow (1950)
(b) Sigmund Freud (1902)
(c) Mark and Ervin (1970)
(d) Dollard (1939)
(e) Bandura (1973)
Answer: A

232. A person who is motivated displays:
(a) Unconscious Behaviour
(b) Conscious Behaviour
(c) Hapazard Behaviour
(d) Goal-directed Behaviour
(e) Erratic Behaviour
Answer: D

233. The process of maintaining the biochemical balance or equalibrium throughout human body is referred as:
(a) Osmosis
(b) Circulation
(c) Hoeostasis
(d) Nervous System
(e) Diffusion
Answer: C

234. Which one of the following is not a psychological motive?
(a) Need for achievement
(b) Need for affection
(c) Need for belonging
(d) Need for Oxygen
(e) None of the above
Answer: D

235. 'The competition of two or more contradictory impulses, usually accompanied by emotional tension is called a/an:
(a) Conflict
(b) Anxiety
(c) Neurosis
(d) Psychosis
(e) Phobia
Answer: A

236. An object or thing which directs or stimulates behaviour:
(a) Instinct
(b) Incentive
(c) Need
(d) Motive
(e) Drive
Answer: B

237. A pituitary hormone associated with the secretion of milk is known as:
(a) Prolactin
(b) Adrenalin
(c) Estrogens
(d) Progesterones
(e) Insulin
Answer: A

238. A motive that is primarily learned rather than basing on biological needs is known as:
(a) Physical Motive
(b) Psychological Motive
(c) Neurophysiological Motive
(d) Psychological Motive
(e) None of these
Answer: D

239. During 1950s, psychologists began to be disenchanted with the drive reduction theory of motivation as an explanation of:
(a) All types of behaviour
(b) Only certain types of physiological behaivour
(c) Only certain types of psychological behaviour
(d) Both physiological and psychological behaviour
(e) Social behaviour
Answer: A

240. The hypothalamus plays an important role in the regulation of:
(a) Food intake
(b) Water intake
(c) Alcohol intake
(d) Both food and water intake
(e) None of the above
Answer: A

241. Lateral hypothalamus (LH) is otherwise known as:
(a) Stimulating centre
(b) Circulatory Centre
(c) Feeding Centre
(d) Water centre
(e) None of the above
Answer: C

242. Research evidences indicated that ventromedial hypothalamus (VMH):
(a) Facilitates eating
(b) Expedites eating
(c) Both facilitates and
(d) Inhibits eating expedites eating
(e) None of the above
Answer: D

243. Electrical stimulation of ventromedial hypothalamus (VMH) cells:
(a) Inhibits eating
(b) Facilitates eating
(c) Expedites eating
(d) Both expedites and inhibits eating
(e) None of the above
Answer: A

244. Injections of glucose (which raise blood sugar level):
(a) Facilitate eating
(b) Expedite eating
(c) Both expedite and facilitate eating
(d) Inhibit eating
(e) None of the above
Answer: D

Answer: D

245. Injections of insulin (which lower blood sugar level):
(a) Increase food intake
(b) Decrease food intake
(c) Expedite food intake
(d) Facilitate food intake
(e) None of the above
Answer: A

246. Studies indicated that the hypothalamus contains cells (glucoreceptors) sensitive to the rate of which:
(a) Glucose passes through them
(b) Glucose stimulates them
(c) Glucose inhibits them
(d) Glucose both stimulates and inhibits them
(e) None of the above
Answer: A

247. An empty stomach produces the periodic contractions of muscles in the stomach wall which we identify as:
(a) Stomach ache
(b) Stomach pain
(c) Stomach ailment
(d) Hunger Pangs
(e) None of these

248. Obesity is thought to stem from disturbances during the:
(a) Phallic stage of psychosexual development
(b) Oral and Anal stages of psychosexual development
(c) Genital stage of psychosexual development
(d) Latency period of psychosexual development
(e) None of these
Answer: B

249. Dehydration of the osmoreceptors can be produced by depriving the organism of:
(a) Food
(b) Water
(c) Blood
(d) Sugar
(e) Alcohol
Answer: B

250. Water deficit in the body increases the concentration of:
(a) Pottasium
(b) Insulin
(c) Sugar
(d) Sodium

(e) Glucose
Answer: D

251. Realistic anxiety is otherwise known as:
(a) Objective anxiety
(b) Subjective anxiety
(c) Psychic anxiety
(d) Ego defenses
Answer: A

252. In "moral anxiety", ego's dependence upon:
(a) Superego is found
(b) Id is found
(c) Sex is found
(d) Unconscious is found
Answer: A

253. Neurotic anxiety is one in which there occurs emotional response to a threat to ego that the impulses may break through into:
(a) Consciousness
(b) Unconsciousness
(c) Subconsciousness
(d) Super ego
Answer: A

254. Sometimes the superego gives threats to punish the ego. This causes an emotional response called:
(a) Moral Anxiety
(b) Realistic Anxiety
(c) Objective Anxiety
(d) Neurotic Anxiety
Answer: A

255. Always we want to protect ego from the ensuring anxiety. For doing this, ego adopts some strategies which are called:
(a) Defense mechanisms
(b) Sex energy
(c) Instincts
(d) Dreams
Answer: A

256. Defense mechanisms help the person in protecting ego from open expression of id impulses and opposing:
(a) Superego directives
(b) Death Instinct
(c) Lie Instinct
(d) Unconscious mind
Answer: A

257. Defense mechanisms operate at unconscious level. They occur

without awareness of the individual. Hence they are:
(a) Self-explanatory
(b) Self-deceptive
(c) Self-expressive
(d) Self-dependant
Answer: B

258. A child scolded by his father may hit his younger sublings. This is an example of:
(a) Displacement
(b) Rationalization
(c) Regression
(d) Repression
Answer: A

259. "A young woman after fighting with her husband returned to her parent's home only to allow her parents to "baby" her and fulfil her every wish like that of a child". This is an illustration of:
(a) Repression
(b) Regression
(c) Fixation
(d) Reaction Formation
Answer: B

260. The last stage of psychosexual development is:
(a) Phallic Stage
(b) Genital Stage
(c) Oral Stage
(d) Anal Stage
Answer: B

261. Sigmund Freud has regarded the first three stages of psychosexual development i.e., the period of 5 or 6 years of life, to be decisive for the formation of:
(a) Intelligence
(b) Personality
(c) Emotion
(d) Ego
Answer: B

262. In the book "Group Psychology and the Analysis of the Ego", Freud has explained the formation of:
(a) Personality
(b) Group
(c) Society
(d) Gang
Answer: B

263. Freud had published a book "Totem and Taboo" in 1913. By publishing this book, he has shown his concern for:
(a) Social Psychology

(b) Abnormal Psychology
(c) Industrial Psychology
(d) Child Psychology
Answer: A

264. Who viewed, "A person is brown with sex, lives in sex and finally dies in sex" ?
(a) J. Herbart
(b) Sigmund Freud
(c) Alfred Adler
(d) C.G. Jung
Answer: B

265. Who said that after birth, the child has a strong frustrating experience?
(a) Sigmund Freud (1917)
(b) Otto Rank (1929)
(c) Alfred Alder (1920)
(d) C.G. Jung (1919)
Answer: B

266. "Penis envy" is found in girls in:
(a) Oral Stage
(b) Anal Stage
(c) Genital Stage
(d) Pohallic Stage
Answer: D

267. Homosexuality is a derivative of:
(a) Electra Complex
(b) Oedipus Complex
(c) Libido
(d) Death Instinct
Answer: B

268. The Oral, Anal and Phallic stages of Psychosexual Development are called:
(a) Pregenital Period
(b) Sexual Genesis
(c) Life Instinct
(d) Latency Period
Answer: A

269. The genital stage is generally characterized by object choices rather than by:
(a) Libido
(b) Narcissim
(c) Personality
(d) Superego
Answer: B

270. In Anal Stage of Psychosexual Development, pleasure is derived from:
(a) Thinking
(b) Libido

(c) Emotion
(d) Expulsion and Retention
Answer: D

271. The "Super ego" is the equivalent of what is more commonly known as the:
(a) Conscience
(b) Personality
(c) Libido
(d) Narcissism
Answer: A

272. The psychoanalysis performed in a controlled setting is known as:
(a) Psychotherapy
(b) Chemotherapy
(c) Hypoanalysis
(d) Hyperanalysis
Answer: C

273. A state of deep unconsciousness, with non-responsiveness to stimulation, is known as:
(a) Coma
(b) Fixation
(c) Hypnotism
(d) Trauma
Answer: A

274. In 1895, Freud and Breuer published a book entitled:
(a) Studies in Hysteria
(b) Interpretation of Dreams
(c) Moses and Menotheism
(d) Psychopathology of Everyday Life
Answer: A

275. Studies of Freud and Breuer reported successful treatment of hysterical symptoms by a method called:
(a) Hypnosis
(b) Free Association
(c) Catharsis
(d) Dream Analysis
Answer: C

276. The success of the cathartic method was regarded by Freud as evidence of the:
(a) Unconscious
(b) Conscious
(c) Subconsious
(d) Libido
Answer: A

277. From the experiences in hypnotism and catharsis, Freud's theory of:
(a) Unconscious was derived

(b) Conscious was derived
(c) Narcisssim was derived
(d) Dream was derived
Answer: A

278. Dreams represent demands or wishes stemming from the:
(a) Unconscious
(b) Conscious
(c) Preconscious
(d) Death Instinct
Answer: A

279. In a special book, Freud analyzed the psychology of error and found the source of errors in the conflict between:
(a) Ego and Super ego
(b) Unconscious wish and conscious censorship
(c) Conscious wish and unconscious censorship
(d) Ego and Preconscious
Answer: B

280. The parts of the body that are capable of reacting to sexual stimuli are called:
(a) Erotogenic Zones
(b) Abnormal Zones
(c) Sensitive Zones
(d) Secular Zones
Answer: A

281. The main erotogenic zone of our body is:
(a) Mouth
(b) Genitals
(c) Anal Zones
(d) Lips
Answer: B

282. According to Freud, the entire activity of men is bent upon procuring pleasure and avoiding pain. This activity is controlled by:
(a) Reality Principle
(b) Pleasure Principle
(c) Primary Narcissism
(d) Secondary Narcissim
Answer: B

283. The urethral development stage is an introductory period to the:
(a) Oral Stage
(b) Phallic Stage
(c) Genital Stage
(d) Latency Stage
Answer: B

284. The very term "Phallic" is derived from "Phallos", which means:
(a) Penis in erection
(b) Sexual urge
(c) Ego-conflict
(d) Self-Love
Answer: A

285. Urethral eroticism is mainly:
(a) Autoerotic
(b) Conscious
(c) Unconscious
(d) Egocentric
Answer: A

286. According to Freud, the negative Oedipus complex may lead to:
(a) Heterosexuality
(b) Homosexuality
(c) Narcissism
(d) Castration
Answer: B

287. The idea of developmental stages was borrowed by Freud from:
(a) Biology
(b) Sociology
(c) Anthropology
(d) Physics
Answer: A

288. The diversion of a part of the sexual energy into non-sexual activities is called:
(a) Repression
(b) Regression
(c) Rationalization
(d) Sublimation
Answer: D

289. The term "defense mechanism" was introduced by:
(a) Freud in 1894
(b) Jung in 1902
(c) Alfred Adler in 1905
(d) Sullivan in 1935
Answer: A

290. Moving away from the reality is called the mechanism of:
(a) Withdrawal
(b) Denial
(c) Daydream
(d) Introjection
Answer: B

291. The stimulation of a muscle fibre by a motor neuron occurs at the
(a) myofibril

(b) transverse tubules
(c) neuromuscular junction
(d) sarcoplasmic reticulum
Answer: (c)

292. An injury sustained by the hypothalamus is most likely to interrupt
(a) coordination during locomotion
(b) short term memory
(c) regulation of body temperature
(d) executive function like decision making
Answer: (c)

293. In humans, the Alzheimer disease is linked with the deficiency of
(a) acetylcholine
(b) dopamine
(c) glutamic acid
(d) Gamma Amino Butyric Acid (GABA)
Answer: (a)

294. What is the person with these symptoms suffering from? Outbursts of emotions, unpredictable moods, quarrelsome behaviour, conflicts with others
(a) Mood disorders
(b) Addictive diroders
(c) Schizoprenia
(d) Borderline personality disorder (BPD)
Answer: (d)

295. Even after the brain of a frog has been crushed, it still responds to a pinch on the leg by drawing it away. This act is an example of
(a) Conditioned reflex
(b) Simple reflex
(c) Automated motor response
(d) Neurotransmitter induced response
Answer: (b)

296. Which of these functions will be affected if the medulla oblongata is damaged?
(a) Vision
(b) Thermoregulation
(c) Memory
(d) Tactile sensation – response when prickled with a needle
Answer: (d)

297. This part of the human brain is also known as the emotional brain
(a) Epithalamus
(b) Limbic system

(c) Broca's area
(d) Corpus callosum
Answer: (b)

298. This is the outermost cranial appendage
(a) Dura mater
(b) Pia mater
(c) Skull
(d) Arachnoid
Answer: (a)

299. This cranial meninges is in close proximity of the brain tissue
(a) Dura mater
(b) Pia mater
(c) Arachnoid
(d) Skull tissue
Answer: (b)

300. This statement is not associated with midbrain
(a) the ventral portion of the midbrain is composed of mainly four, round swellings known as corpora quadrigemina
(b) located between thalamus of the forebrain and pons of the hindbrain
(c) the canal called cerebral aqueduct passes through the midbrain
(d) hindbrain and midbrain constitute the brain stem
Answer: (a)

301. This hormone is produced under condition of stress which stimulates glycogenolysis in the liver of human beings
(a) Insulin
(b) Thyroxin
(c) Estradiol
(d) Adrenaline
Answer: (d)

302. Fight or flight reactions causes the activation of
(a) the parathyroid glands, leading to increased metabolic rate
(b) adrenal medulla leading to increased secretion of epinephrine and norepinephrine
(c) pancreas leading to a reduction in the blood sugar levels
(d) the kidney, causing suppression of the renin-angiotensin-aldosterone pathway
Answer: (b)

303. After trying for several years, a couple finally learnt that they are

going to have a baby. They are experiencing this type of stress
(a) Strain
(b) Anxiety
(c) Distress
(d) Eustress
Answer: (d)

304. This part of the autonomic nervous system provides the body with energy for the fight-or-flight response
(a) Central nervous system
(b) Sympathetic nervous system
(c) Peripheral nervous system
(d) Parasympathetic nervous system
Answer: (b)

305. A real or perceived challenge or threat which causes the body to produce a response is a(n)
(a) injury
(b) phobia
(c) stressor
(d) frustration
Answer: (c)

306. The hormone released by the adrenal glands allows the body to make energy more readily available from the stored nutrients
(a) ACTH
(b) Cortisol
(c) Epinephrine
(d) Norepinephrine
Answer: (b)

307. When danger or stress is perceived/experienced, this response occurs in the body
(a) Exhaustion
(b) Adaption
(c) Fight-or-flight
(d) Resistance
Answer: (c)

308. This branch of science investigates the relationship between stress and the nervous and immune systems
(a) Neurolinguistics
(b) Sociology
(c) Adaptive immunology
(d) Psychoneuroimmunology
Answer: (d)

309. All of the following is true about the hormone epinephrine except that it
(a) is released by the pituitary gland
(b) is also known as adrenaline
(c) is secreted by the adrenal gland

(d) prepares the body for action
Answer: (a)

310. The primary hormone responsible for stress-related physiological responses, such as an increase in heart rate is
(a) insulin
(b) cortisol
(c) epinephrine
(d) thyroxin
Answer: (c)